Technology Review

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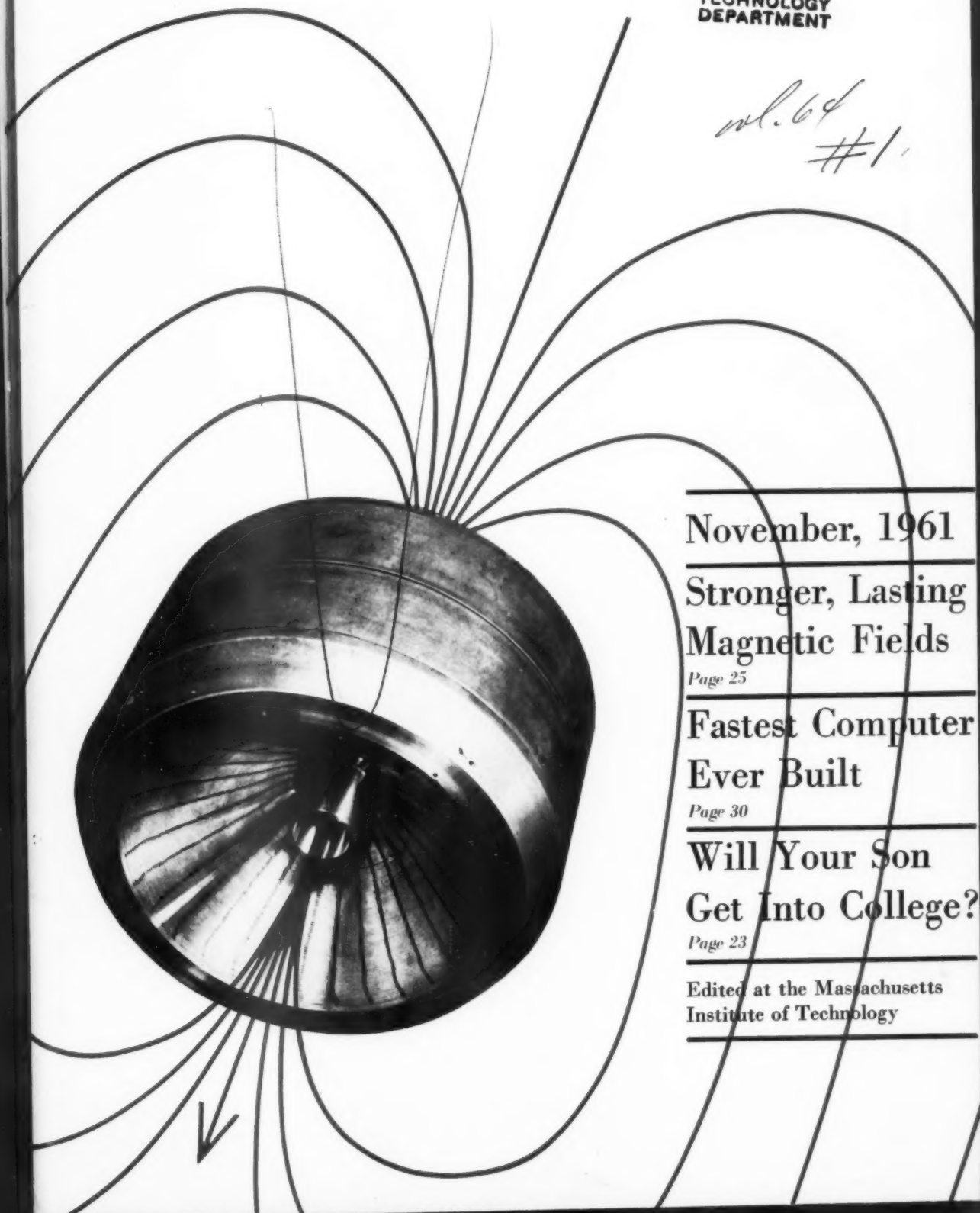
vol. 64 #1



November, 1961

Stronger, Lasting Magnetic Fields

Page 25

Fastest Computer Ever Built

Page 30

Will Your Son Get Into College?

Page 23

Edited at the Massachusetts Institute of Technology

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Enhancing a location in the educational and research center of the nation . . . C-E-I-R, Inc. will install in 545 Technology Square the world's largest commercial computing center. ■ A limited amount of space is available in 545 Technology Square for occupancy in June, 1963. Leasing of 575 Technology Square is underway in units from 5,000 square feet.

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Creative Senior Scientists sought to work with **Dr. Steven M. Sussman,** Head of the Communications Theory Laboratory or **Dr. Bernard Friedland,** both at Melpar's Applied Science Division.

(1) Communications Theory. Perform logical design of digital data processing in implementation of coding techniques for communications systems, working closely with computer programmers on system simulation, B.S. or M.S. degree in E.E. **(2)** Evolve techniques for communication over channels with additive and multiplicative disturbances and doppler shift with particular emphasis on synchronization methods. M.S. or Ph.D. degree in E.E. (Communications Theory). **(3) Control Systems Design Theory.** Perform theoretical investigations of problems in Control Systems Design. Background required in E.E. and Applied Mathematics including differential equations, numerical methods, classical analysis, and analog and digital computer principles. M.S. or Ph.D. in E.E. or Applied Mathematics.

For information on the two positions in Communications Theory write or phone Dr. Steven Sussman, Head, Communications Theory Laboratory. Further information on the Control Systems Design Theory position is available through Dr. Bernard Friedland. Correspondence and inquiries will be held in strictest confidence.

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Technology Review

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Volume 64, Number 1 *Edited at the Massachusetts Institute of Technology* *November, 1961*

Feedback

The Most Wanted Class?

FROM JOSEPH S. KAMING, JR., '56

Our national attention is constantly being directed to a shortage of engineers and scientists. Insight into this problem can be gained by reviewing the experiences of the M.I.T. Class of 1956. The class was heralded upon graduation by a feature article in *Life* magazine, "A Quest For Quality In Scientists" (May 7, 1956), and patronized by a then existing economic boom and imagined American technological superiority. To pre-graduation interviewers, this was the nation's "most wanted" class. Now unfortunately the class members, generally, find themselves wanting of opportunity to use their education. The occupational demands upon them are far less than talent consuming.

The fifth reunion of the '56 class, held this June, disclosed something other than buoyant optimism. Underutilization of talent, combined with unpredictable defense industry layoffs and a personalized awareness that the politics of business control the quality of engineering, evokes from the graduates an unglamorized evaluation of their profession.

The class members are not dissatisfied with their M.I.T. education. In retrospect, the education—expansion of thought from the infusion of new ideas, development of technical skills and knowledge, the discipline of persistence and intense concentration, exposure to a certain portion of inspiring faculty members, and acquaintance with an exceptionally select student body—is characterized as excellent by the majority of the '56ers. They would send their children to M.I.T.—Tech, money and children willing.

What the Tech men are disappointed about is the lack of opportunity to use their education. Engineering and science do sift the unknown, extracting its fascinations; however, the vast majority of technical positions are decidedly ancillary to the

(*Continued on page 66*)

IN FINE FORM *after a summer spent taking photos below the sea, Professor Harold E. Edgerton, '27, addressed the Class of 1965 this fall. Here you see him showing one of his many examples of high-speed photography. To see the freshmen, please turn to pages 19 and 24.*

EDITOR: Volta Torrey; BUSINESS MANAGER: R. T. Jope, '28; CIRCULATION MANAGER: D. P. Severance, '38; EDITORIAL ASSOCIATES: J. J. Rowlands, Francis E. Wylie, John I. Mattill; EDITORIAL STAFF: Ruth King, Joan B. Brassert, Roberta A. Clark; BUSINESS STAFF: Madeline R. McCormick, Patricia A. Fletcher; PUBLISHER: H. E. Lobdell, '17.

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The magnet shown produced the most powerful continuous field yet attained, and is further described on page 25.

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Individuals Noteworthy

Corporation Members

THE ELECTION of two life members, four Alumni to serve five-year terms, and one ex-officio member of the M.I.T. Corporation was announced in July by Chairman James R. Killian, Jr., '26.

The new life members are *Edward J. Hanley, '24,* President and Director of the Allegheny Ludlum Steel Corporation, and *Robert A. Lovett,* former Secretary of Defense and a bank executive in New York City. Mr. Hanley was president of the Alumni Association in 1959-1960, and has been an alumni term member of the Corporation since 1956. Mr. Lovett, a Yale graduate, served as a special term member of the Corporation from 1955 to 1960.

The Alumni elected to serve five-year terms are *U. A. Whitaker, '23,* President, Treasurer, and Director of Aircraft-Marine Products in Harrisburg, Pa.; *John R. Kimberly, '26,* Chairman of the Board of the Kimberly-Clark Corporation in Neenah, Wis.; *Robert B. Semple, '32,* President of the Wyandotte Chemicals Corporation of Wyandotte, Mich.; and *William B. Bergen, '37,* President of the Martin Company in Baltimore.

D. Reid Weedon, Jr., '41, who is now President of the Alumni Association, will serve for one year as ex-officio member. Mr. Weedon is vice-president of Arthur D. Little, Inc., of Cambridge.

CERN's Director General

ON AUGUST 1, Professor Victor F. Weisskopf, on leave of absence from M.I.T., took office as the Director General of CERN, the European Organization for Nuclear Research in Myrin, near Geneva, Switzerland. CERN has an annual budget of nearly $16,000,000 and operates as part of its research program a 28 billion-electron-volt proton accelerator. (Work being done with it is described on page 26.)

Professor Weisskopf succeeds John B. Adams of England in this post, which he will hold for two years. His appointment was considered extraordinary because he is an American citizen and the United States is not a member of CERN.

Before coming to this country, Professor Weisskopf worked with Werner Heisenberg, Erwin Schroedinger, Wolfgang Pauli, and other noted physicists in Europe. He received the Max Planck medal of the German Physical Society in 1956, and was president last year of the American Physical Society.

FRANK G. DENISON, '40, a naval architect, is Lunar Systems Manager of Ford's Aeronutronic Division, responsible for designing and building the first instrumented package which the U.S. plans to land on the moon sometime next year.

ROBERT C. MEISSNER, '43, pictured (at left) with President Joaquin Balaguer of the Dominican Republic, heads the firm retained to develop a Dominican Republic deposit of high-grade iron ore which is believed to be the largest in the Western Hemisphere. Mr. Meissner's home office is in Chicago.

Planners for Venezuela

THE Joint Center for Urban Studies of M.I.T. and Harvard has appointed Norman Williams, Jr., as over-all director, and Wilhelm V. von Moltke to be in charge of urban design, on the $900,000 project it has undertaken for the Corporacion Venezolana de Guayana.

The Center's staff will prepare an economic development program for Venezuela's entire Orinoco valley and a general plan for a new industrial city to be called Santo Tomas de Guayana.

Mr. Williams was formerly chief of the office of master planning of New York City, and was visiting professor of city planning at M.I.T. last year. Mr. von Moltke was formerly on the staff of the Philadelphia Planning Commission and recently completed a year as visiting critic on urban design at Harvard.

(Continued on page 6)

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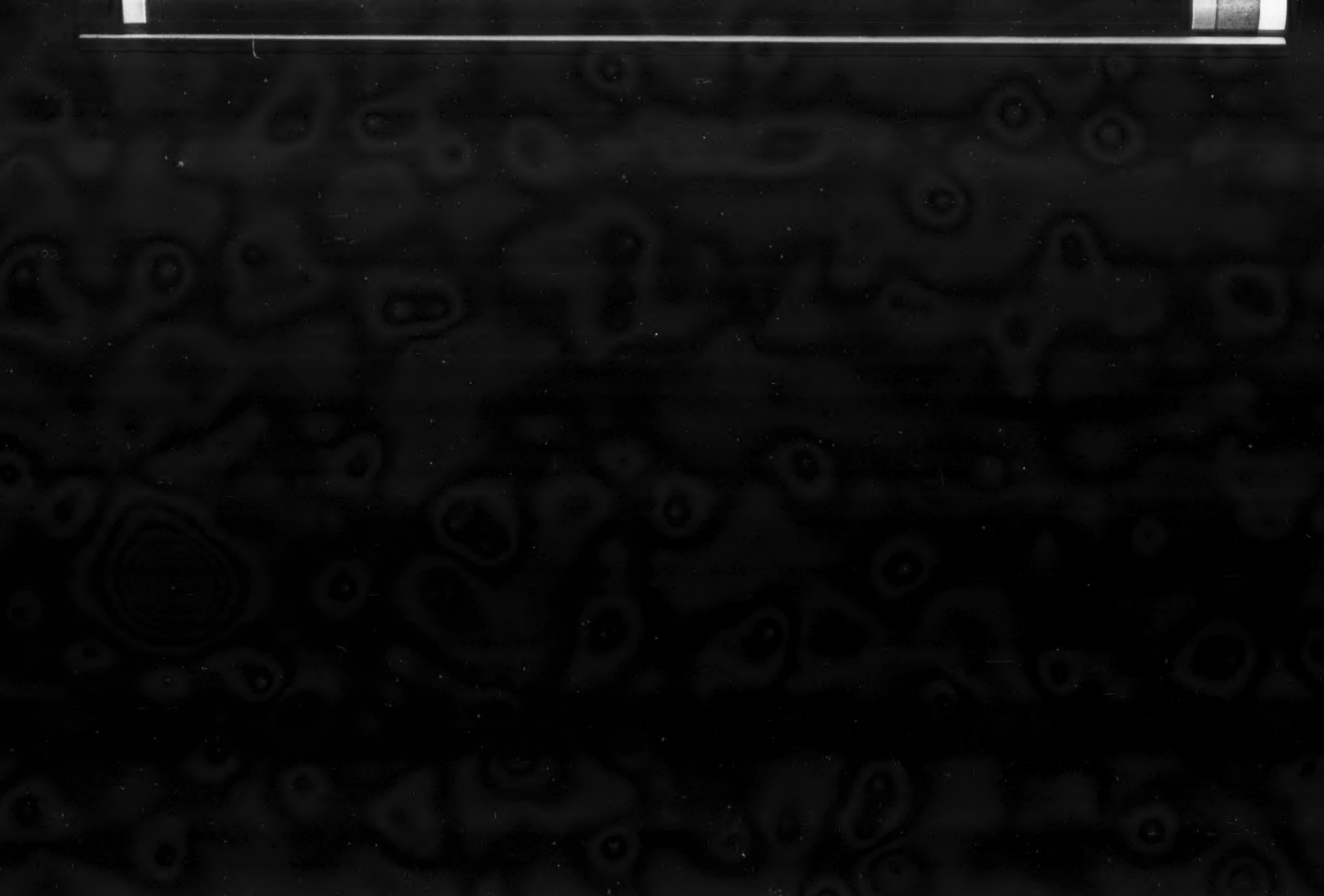

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Increased technical responsibilities in the field of range measurements have required the creation of new positions at the Lincoln Laboratory. We invite inquiries from senior members of the scientific community interested in participating with us in solving problems of the greatest urgency in the defense of the nation.

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Individuals Noteworthy

(Continued from page 4)

Honors from Schools

RECIPIENTS, honorary degrees, and institutions bestowing them include: *Robert E. Wilson, '16,* of laws, the American University . . . *Crawford H. Greenewalt, '22,* of laws, Swarthmore College . . . *Latimer F. Hickernell, '22,* of engineering, Polytechnic Institute of Brooklyn; *Chaplin Tyler, '23,* of science, Northeastern University . . . *James C. Evans, '25,* of humane letters, The Agricultural and Technical College of North Carolina . . . *Claude E. Shannon, '40,* of science, the University of Michigan.

Research Fellows

TEN ALUMNI hold Ford Foundation post-doctoral fellowships in Engineering at M.I.T. this year. They are *William G. Moffatt, '53, Paul E. Gray, '54, Frederic R. Morgenthaler, '55, Charles C. Robinson, '55, James G. Gottling, '56, John P. Penhune, '57, Robert M. Rose, '58, Paul L. Penfield, Jr., '60, George Zames, '60,* and *Thomas R. Clevenger, Jr., '61.*

(Continued on page 10)

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The joint U.S. Air Force-AEC Project SPUR is a research and development program being conducted by an industry team of Garrett, Aerojet-General Nucleonics (reactor) and Westinghouse, Lima (generator) to provide a power source to produce 300-1000KW electrical power in space for one year or more. Power is obtained by conversion of nuclear fission energy to mechanical (shaft) power with a potassium vapor turbine. Equipment includes: reactor, primary and secondary loop pumps, boiler, turbo-generator and condenser-radiator.

Long lead time is essential to the development of large nuclear space power systems. Present methods of power generation would require an impractical heat rejection surface nearly the size of a football field for a power output of one megawatt—power which will be needed for critical space missions already in the planning stage.

Garrett's AiResearch Divisions have now completed the initial SPUR design studies and proved the project's feasibility to supply continuous accessory power and low thrust electrical propulsion in space for long periods of time.

Cutting projected 1 MW power systems to 1/10th the size and 1/5th the weight of present power systems under development will be possible because of SPUR's capability to operate at higher temperatures, thereby sharply reducing the required radiator area.

Garrett has been working with the Air Force and the Atomic Energy Commission on SPUR as the prime contractor for more than one year and has more than five years of experience in space nuclear power development. Also an industry leader in high speed rotating machinery, heat transfer equipment, metallurgy and accessory power systems, the company is developing design solutions for SPUR in these critical component system areas.

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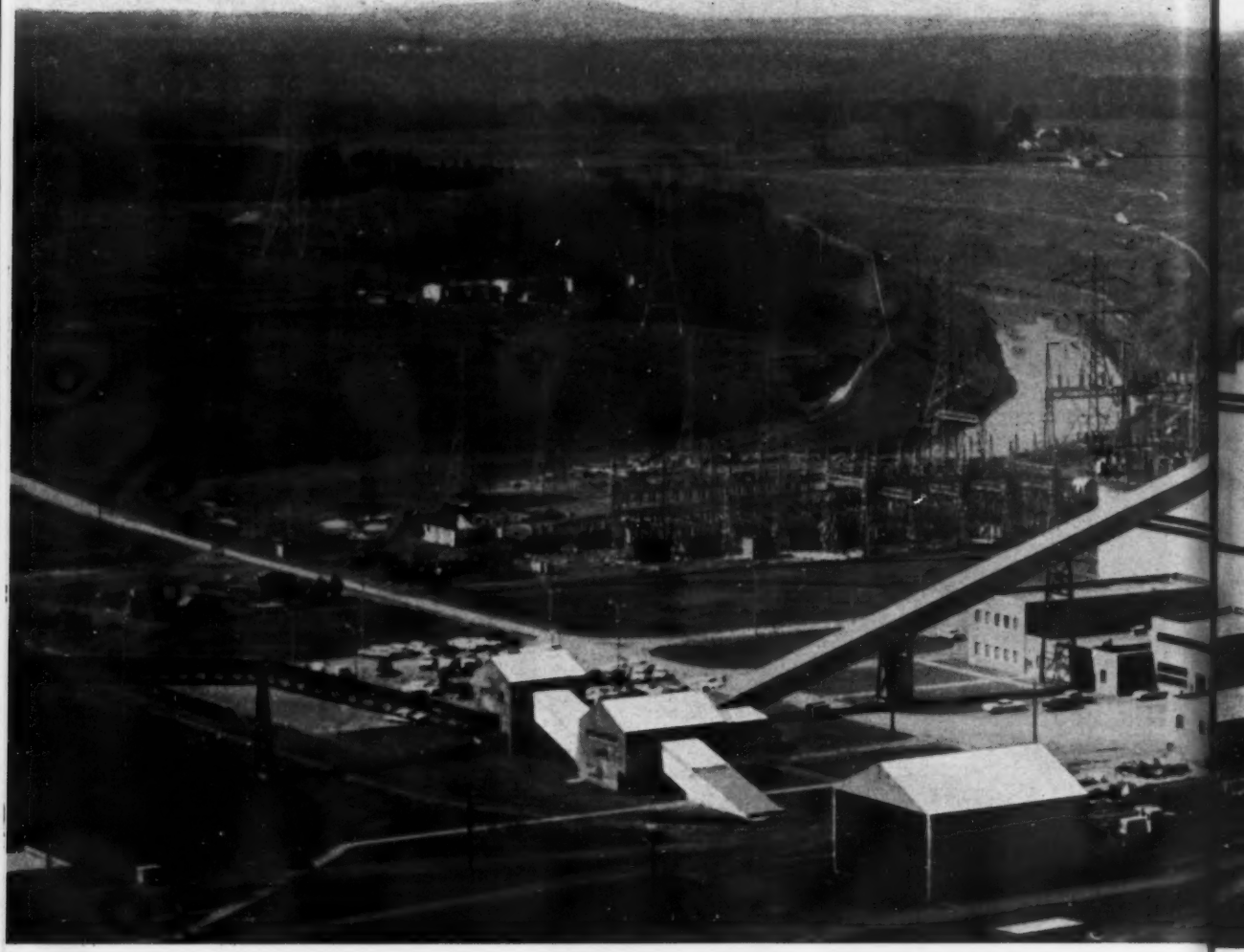
100th C-E Controlled Circulation Steam Generator in Service

Here, at the Allen Plant of the Duke Power Company, Belmont, N. C., an important milestone was reached late last year when C-E's 100th Controlled Circulation Steam Generator was placed in service. This is the fourth such unit to be installed at Allen and a fifth is now under construction. Duke Power Company also has units of this type installed in four other generating stations.



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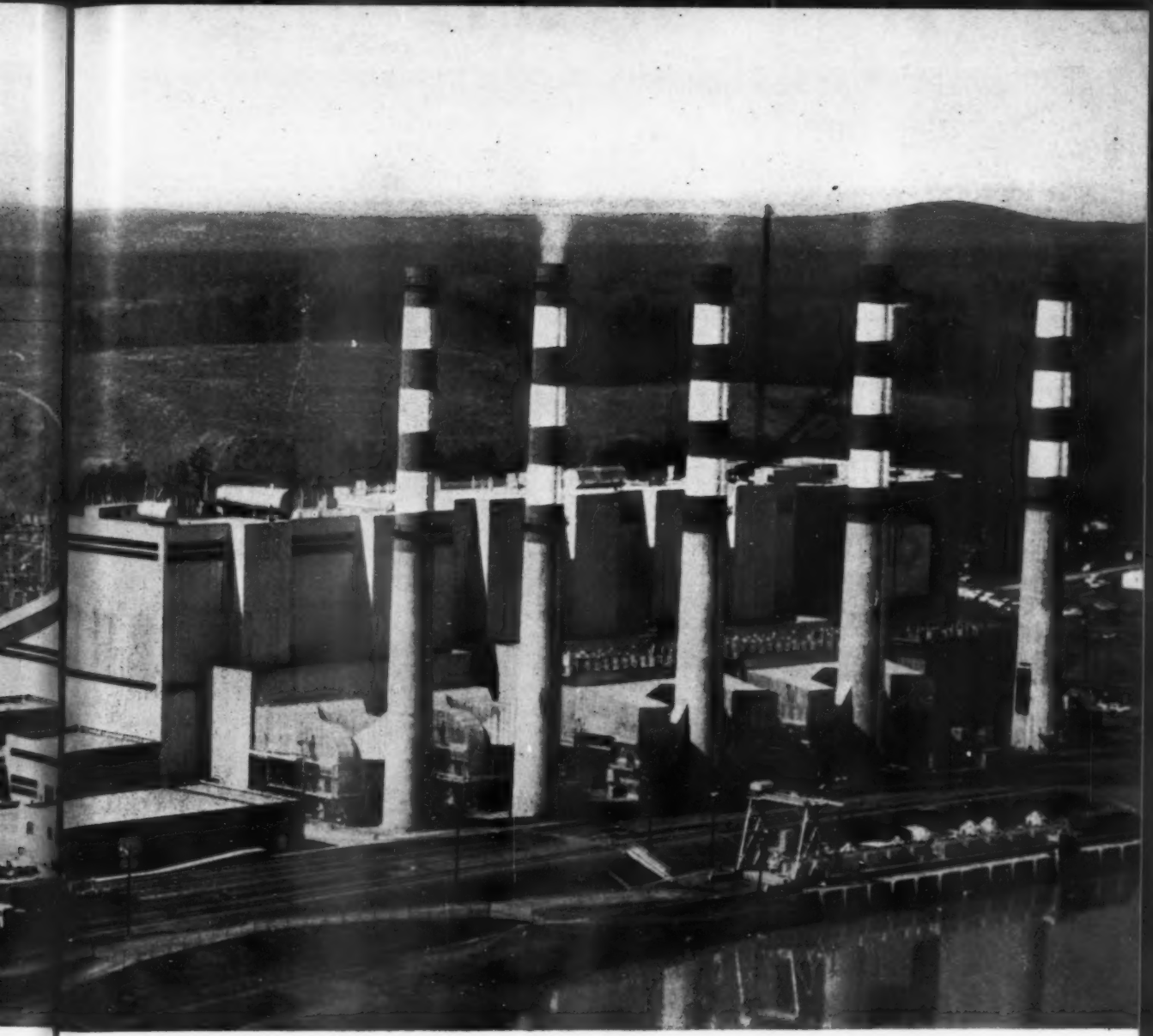

AMERICA'S BIGGEST BARGAIN

acceptance of this design for high pressure utility installations that orders placed during the past decade represent an aggregate capacity of about 30 million kilowatts, or, expressed in dollars, about $750 million.

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Background of the Controlled Circulation Steam Generator

The first installation was made in the Somerset Station of the Montaup Electric Company in 1942. Following years of extensive study and test of this pioneering installation, the generator was offered as a fully developed and proven design in 1950. In that year, several large utilities placed orders, the first being from the Virginia Electric & Power Company for its Chesterfield Station. It is interesting to note that Stone & Webster Engineering Corporation, consulting engineers for the original installation at Montaup, were also consultants for the Chesterfield installation. The trend to controlled circulation and higher pressures was under way and was soon to become the most significant trend in contemporary steam power practice.

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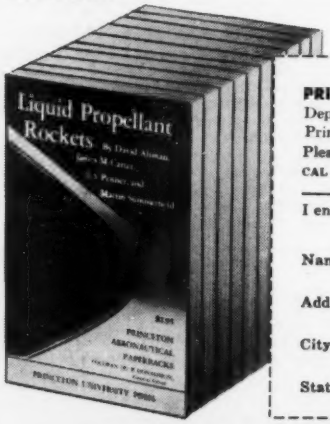

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Individuals Noteworthy

(*Continued from page 6*)

Honors to Alumni

SPECIAL awards to Alumni reported since last July included:

Samuel A. Greeley, '06, the Emerson Award, by the Water Pollution Control Federation, Washington, D.C. . . . *Vannevar Bush, '16,* honorary membership in the American Society for Engineering Education;

Manuel S. Vallarta, '21, membership in the Papal Academy of Science . . . *W. Barton Jones, '22,* a Fellow of the Instrument Society of America . . . *Miles N. Clair, '23,* a Distinguished Citizen Tribute, by the City of Philadelphia;

Samuel Levine, '27, Superior Performance Award, by the U.S. Patent Office . . . *Gordon Bunshaft, 33,* the Medal of Honor, by the New York Chapter, American Institute of Architects . . . *Donald McDonald, '41,* the 1961 Award of Merit, by the National Electronics Conference;

John H. Holland, '50, the Louis E. Levy Medal, by The Franklin Institute . . . *Merton C. Flemings, Jr., '51,* the Peter L. Simpson Gold Medal, by the American Foundrymen's Society.

(*Continued on page 44*)

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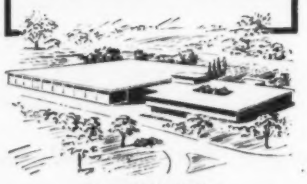

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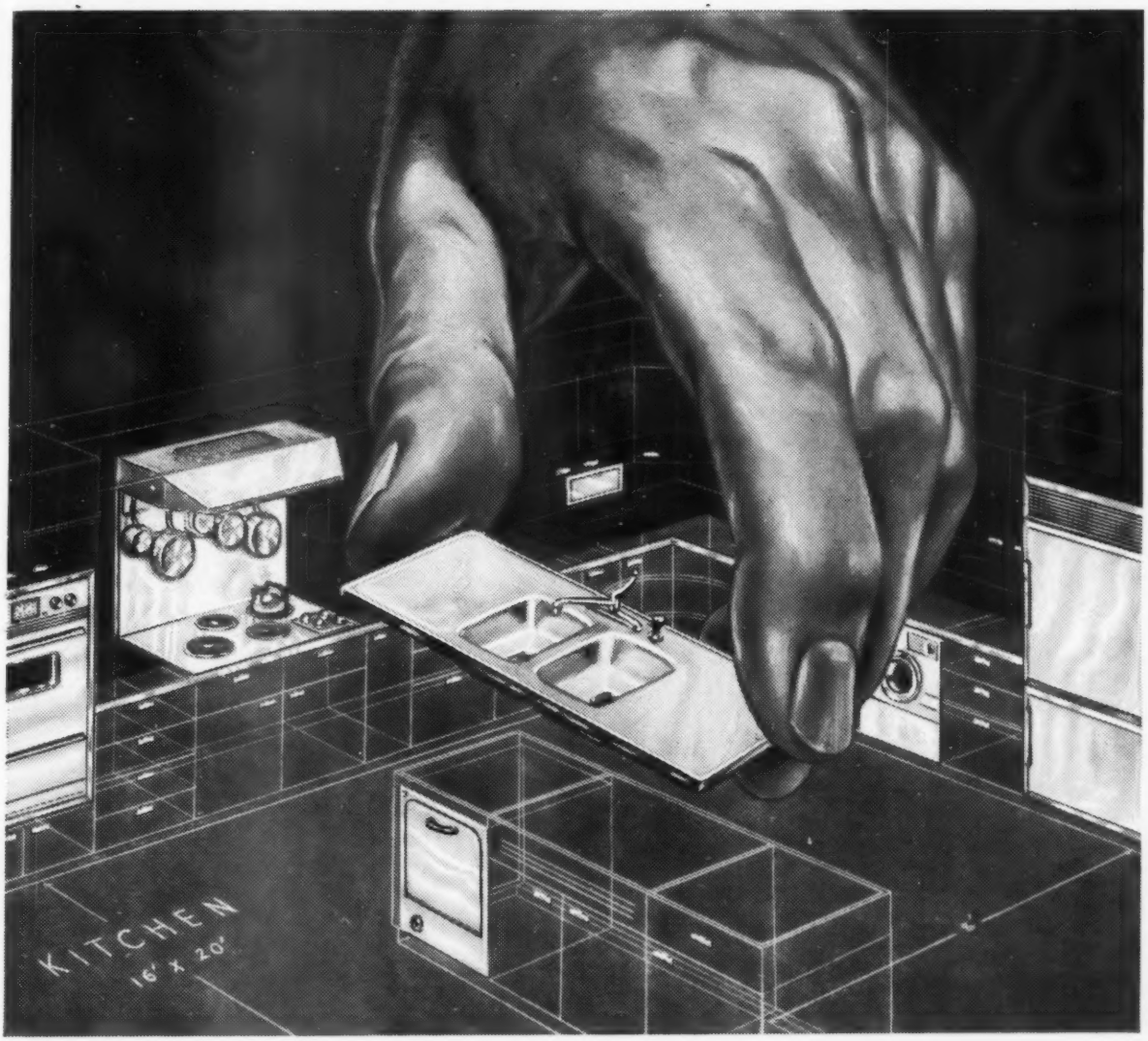

Build with the carefree beauty of stainless steel

Handsome appliances and gleaming counter tops that stay bright and are so easy to wipe clean...even the kitchen sink becomes a thing of beauty when it is made of shining stainless steel —the useful metal that was developed after years of research.

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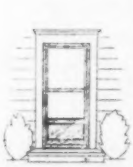

The secret of stainless steel lies in chromium—one of many indispensable alloying metals developed by Union Carbide. They are typical of the hundreds of basic materials created through research by the people of Union Carbide in metals, as well as carbons, chemicals, gases, plastics and nuclear energy.

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Said J. Stefan and L. Boltzmann: *"The total radiation from a black body is proportional to the fourth power of the absolute temperature of the black body."*

Radiation is usually associated with high temperatures. Yet very cold bodies emit a radiation which can be highly significant in missile and space applications. The problem faced by infrared scientists, trying to detect variations in radiation from low temperature atmospheres, can be likened to detecting a one-foot cube of ice from a distance of five miles.

Lockheed Missiles & Space Company scientists are deeply engaged in studying the problems of infrared emission from the earth and its atmosphere, as seen from orbital altitudes. Although the earth resembles a black body at 300° Kelvin, the emission from its atmosphere, under some circumstances, is much colder. To make measurements under these circumstances, Lockheed has evolved radiometric equipment with one of the most sensitive detection systems yet conceived.

Scientists and engineers must also take careful measurements of a potential employer. Lockheed Missiles & Space Company in Sunnyvale and Palo Alto, California, on the beautiful San Francisco Peninsula, invites this close scrutiny. As Systems Manager for the DISCOVERER and MIDAS satellites and the POLARIS FBM, Lockheed preeminence in Missiles and Space creates positions in many disciplines for outstanding engineers and scientists.

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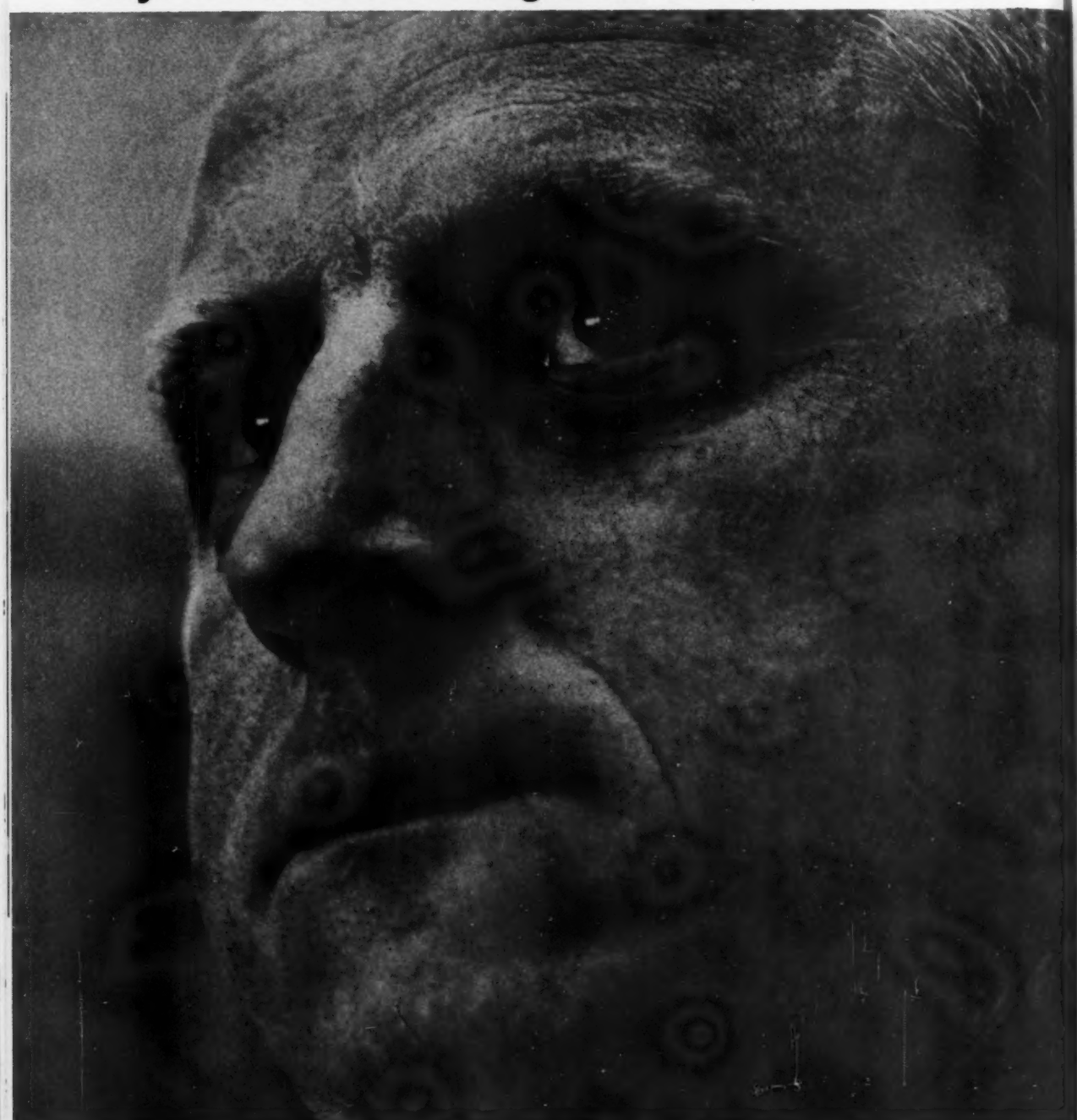

An unsolved problem is a nagging challenge to him. The word "impossible" is an impertinence.

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RADAR SYSTEMS ENGINEERS

To integrate varied data acquisition equipment into complex electronic control systems.

TELECOMMUNICATIONS ENGINEERS

To design and develop advanced communications subsystems of ground electronic control system complex.

SENIOR PROGRAMMERS

Will be responsible for the overall planning and supervision of computer programs. Will assign, outline and coordinate work of programmers and write and debug complex programs involving mathematical equations. Requires experience in the operation and programming of large electronic data processing systems, such as the AN/FSQ-7N8, IBM 700 series, or Philco 2000 series.

COMPUTER PROGRAMMERS

To develop and/or analyze logic diagrams, translate detailed flow charts into coded machine instructions, test run programs and write descriptions of completed programs. Requires experience in the operation and programming of large electronic data processing systems, such as the AN/FSQ-7N8, IBM 700 series, or Philco 2000 series.

TECHNICAL WRITERS

To write and publish technical reports on Communications, Radar, Fire Control Systems, Electrical and Mechanical Devices and Computers.

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To resolve varied grounding and shielding problems of complex electronic equipments.

RADAR DESIGN ENGINEERS

To work on advanced designs—to develop receivers using parametric amplifiers.

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To plan, prepare and generate specifications for sub-systems test, data reduction and analysis programs. Will be responsible for the preparation of test plans, installation of equipment, test instrumentation, collection of test data and analysis of results. Resolve incompatibility and interface engineering problems.

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Why a successful man gave up a career

HBS
The Harvard Business School Bulletin
FEBRUARY 1961
I
SELL INSURANCE—
AND LIKE IT!
With new uses developing for life insurance, both business and personal, an agent's career can be a creative and satisfying one for HBS alumni.
Norman M. Wallack '48, New England Mutual Life Insurance Company, Boston
STANDARD EQUIPMENT for a B-School alumnus is a built-in image of the ideal HBS man: keen, tough-minded, analytical, imaginative, farsighted and resourceful. At the same time, most of us have a mental picture of a life insurance agent: unimaginative, plodding, high-pressure, ill-informed, persistent and annoying.
Given the clash between these two pictures, my Business School friends really raise an eyebrow when they find out that I am one of those "people with endurance — a man who sells insurance." There are very few graduate business school alumni in my end of the business, much less HBS types, though of course we have many alumni among the managerial personnel in the industry. So they immediately want to know how I ever ended up in such an occupation, and sit sadly expecting some horror story of a misspent youth and wasted opportunities.
Actually, the facts bear no resemblance to their assumptions. I am in this business because I like it, because I chose it after trying several other types of work, because it offers all kinds of opportunities for ingenuity in developing special insurance programs for particular companies and individuals. In so doing, I have come to the conclusion that businessmen are so
11

in industry to start one in life insurance

Norman Wallack had good reasons.
Here's the first-hand account he gave us after his article had appeared in the Harvard Business School Bulletin—

"After graduation from Harvard Business School, I did well during the next nine years in two different areas of business. First, as merchandise manager for a large Midwest manufacturer. Next, as developer and owner of a camping-equipment company. But after five years of having my own company, I sold out at a substantial profit. Six months later I had decided to sell life insurance for New England Life.

"I had plenty of confidence by this time in my business ability. Now I wanted to find an area where it would pay off on its own and require little reliance on others. I wanted a field that offered increasing income as I grew older without suddenly dropping off when I reached 65 . . . that held fewer of the frustrations encountered in industry . . . that could put to best use my training at the School, experience and capabilities.

"*Life insurance seemed to come closest to this ideal. So I picked out the company with one of the finest reputations and cost pictures in the industry and sought out one of the most outstanding training agencies in the business.*

"It adds up to this: I'm in this business because I like it. Because I chose it after trying other types of work. Because it offers all kinds of opportunities for developing special insurance programs for companies and individuals. It's the unusual combination of freedom and variety that appeals to me. Perhaps it will appeal to you."

If you'd like a reprint of the 5-page article by Norman Wallack, "I Sell Insurance — And Like It!" just send along the coupon. We'll also mail you our free booklet, "Careers in Life Insurance," which describes the opportunities with New England Life for those men who meet our requirements.

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City.....*Zone*....*State*.....

Arthur C. Kenison, '19, Boston **Blaylock Atherton, '24, Nashua** **John H. Schaefer, '25, Hackensack**
Maurice W. Hanks, '38, Hackensack **Herbert L. Neitlich, '49, Boston**

MH COLLEGE DIVISION

GROUND SUPPORT SYSTEMS FOR MISSILES AND SPACE VEHICLES

By KENNETH BROWN and PETER B. WEISER, University of California, Los Angeles. *University of California Engineering Extension Series.* 490 pages, $15.00.

Presenting a complete description of the systems required to support either a missile or a space vehicle. Directed toward the engineer having no prior acquaintance with ground support systems, the text approaches the system as a whole unit—assuming that the missile is merely one small portion and that each of the subsystems involved is merely an integral part of the overall system. All subsystems are considered with full discussions of recent advances.

FUNDAMENTALS OF HEAT TRANSFER

By GROBER, ERK, and GRIGULL; translated from the German by J. R. MOSZYNSKI, Case Institute of Technology. *McGraw-Hill Series in Mechanical Engineering.* 527 pages, $15.00.

This translation is from the German classic GRUNDSETZE DER WARMENBERTRAGUNG first published in 1933 and revised in 1955. Apart from its value as a classic in literature, the Third Edition as rewritten by Grigull covers all the fundamentals of the subject and gives a very thorough account of European research in heat transfer up until 1955. Bibliography includes important publications since 1955.

SYNTHESIS OF OPTIMUM CONTROL SYSTEMS

By SHELDON S. L. CHANG, New York University. 381 pages, $11.75.

A second-year-graduate-level text bridging the gap between a standard text on the subject and the current literature on optimum control. It may also be used as a supplementary text for a one year graduate course, and as a reference book for industry. The book is designed to equip students with advanced design techniques for high performance systems where the ultimate in response is required.

ELEMENTS OF THERMODYNAMICS AND HEAT TRANSFER, Second Edition

By EDWARD F. OBERT, University of Wisconsin; and ROBERT L. YOUNG, University of Tennessee. Available in January, 1962.

A major revision of a very successful text used primarily in the service course given in the M.E. department to students in other engineering disciplines. The Heat Transfer material has been substantially expanded, an effort has been made to strengthen the mathematical developments of the First and Second Laws, and the theory is built upon the concept of function.

DESIGN MANUAL FOR TRANSISTOR CIRCUITS

By JOHN M. CARROLL, *Electronics,* McGraw-Hill Pub., Co. 376 pages, $9.50.

A selected group of articles from *Electronics* magazine showing an engineer how to design circuits using transistors and other semiconductor devices.

FOUNDATIONS OF STRUCTURES, Second Edition

By CLARENCE W. DUNHAM, Yale University. *The McGraw-Hill Civil Engineering Series.* Available in January, 1962.

An extension and improvement of a successful text dealing with the practical application and theory of foundation engineering and design. As before, it is intended for reference by structural and foundation engineers, and for text use in senior courses in Foundation Engineering or specialized courses in Soil Engineering.

COMPUTER-CONTROL SYSTEMS TECHNOLOGY

Edited by C. T. LEONDES, University of California, Los Angeles. *The University of California Extension Series.* 649 pages, $16.00.

This book, developed from a series of lectures offered at various centers in California, combines a unified, integrated treatment of computer-control systems technology with the presentation of a number of currently significant applications. The first sections of the book deal with the theory of digital and analog computers. Then control theory is studied. Finally these two fields are blended by considering the development of some systems of varying degrees of difficulty.

RECENT ADVANCES IN HEAT AND MASS TRANSFER

Edited by J. P. HARTNETT, University of Minnesota. 404 pages, $9.75.

This book brings together a collection of the most important papers in Heat and Mass Transfer. All the articles have appeared in various journals, magazines or symposia, and have gained wide recognition as outstanding contributions. Of considerable value to all those actively involved in the use of heat transfer information. Suitable as an auxiliary text for graduate courses in transfer processes.

PEACETIME USES OF OUTER SPACE

Edited by SIMON RAMO, Thompson Ramo-Woolridge, Inc. 279 pages, $6.95.

This remarkable volume brings together outstanding scientists, educators, politicians, and businessmen for an examination of the coming space age. Emphasizing the peacetime, non-military aspects of space technology, the book seeks to heighten public responsiveness to the full impact of science and technology in shaping our future. Contributors include: Leston Faneuf, J. H. Doolittle, Lloyd V. Berkner, Congressman Overton Brooks, Ralph J. Cordiner, Willard F. Libby, Vice Admiral John T. Hayward, Joseph Kaplan, Morris Neiburger, Brigadier General Don D. Flickinger, Leo Goldberg, Edward Teller, and Frederick R. Kappel.

PLANNING A COMPUTER SYSTEM: Project Stretch

Edited by W. BUCHHOLZ, IBM Corporation. Available in January, 1962.

This book is primarily concerned with the selection of an instruction set and related functional characteristics of a high-speed digital computer. The specific subject of the work is the powerful and highly sophisticated computer: the IBM 7030. The authors of individual chapters have actively participated in the design project developing this computer and the text thus reflects the substance of direct personal experience. Reasons are given for various design choices and compromises between conflicting requirements are analyzed. Numerous original ideas discussed.

LINEAR VACUUM TUBE AND TRANSISTOR CIRCUITS: A Unified Approach to Linear Active Circuits

By A. J. COTE, Jr. and J. BARRY OAKES, The Johns Hopkins University. *The McGraw-Hill Electrical and Electronic Engineering Series.* 411 pages, $10.75.

This senior-graduate level text presents a basic approach to the analysis and synthesis of linear vacuum tube and transistor circuits, and emphasizes the difference and similarities between these two devices. This viewpoint permits the designer to select the optimum combination of external passive elements that will make the best use of the device employed in a particular application.

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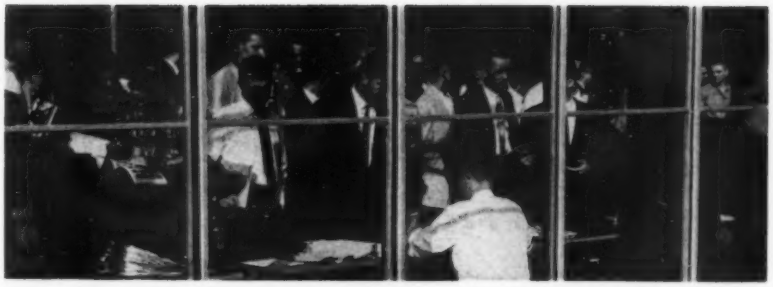
Trend Of Affairs



The Class of 1965

M.I.T. WELCOMED 910 freshmen this fall from 700 secondary schools in 47 states and 25 foreign countries. Eighty-five per cent were in the top tenth of their secondary school classes, and 200 received college credit for advanced achievements. Twenty-five of the new students were women, 36 were children or grandchildren of Alumni, and two were sons of members of the Faculty. *(Some of the freshmen are shown above.)*

Total enrollment at the Institute this year is 6,485, which is 3.1 per cent more than last year. Of the total, 3,595 are undergraduates and 2,890 are graduate students.

The freshmen were addressed at the outset by Professors Edwin H. Land, Hans Mueller, John Wulff, Ascher H. Shapiro, '38, and Harold E. Edgerton, '27, and Deans Kenneth R. Wadleigh, '43, and Howard W. Johnson.

Forty-one special seminars were organized this fall, for the first time, to enable freshmen to work directly with senior members of the Faculty.

Ray Kaempfer, a new student from The Hague, being tutored in miniature geometry in the Computation Center.

Pedagogy Automatized

STUDENTS returning to M.I.T. this fall found a new challenge on the bulletin boards: *TIRED OF HUMAN TEACHERS? THINK A COMPUTER CAN TEACH BETTER? Find out for yourself by taking a one-hour experimental course on the IBM 709. No prerequisites. Freshmen through graduates welcome.*

As part of his work for a doctorate, Richard D. Smallwood, '57, had programmed the big machine in the M.I.T. Computation Center to teach a miniature geometry based on two definitions and four axioms. Fifty-five men signed up for the course pronto, and Smallwood admitted 20 to the high-speed course.

Each student was seated at a microfilm projector with notepaper and an electric typewriter. The machine gave him instructions and put questions to him on the screen of the projector; he answered its queries by punching appropriate keys on the typewriter.

A book of instructions and questions, on 24 different levels, was stored in the computer's memory. The machine determined what material was presented to each student, in the light of its previous experience and its appraisal of each individual's needs. It proceeded, in other words, as though it were playing a game: it considered the possible alternatives at each stage of the course and chose the one that seemed most effective.

The great memory and speed of the 709, Mr. Smallwood thought, should make it superior to simpler teaching machines, and he was seeking an answer to two questions: (1) Would the computer vary its presentation of the material when individuals responded differently to its questions? (2) Could it learn from its experience with different individuals and thus become a better tutor as it gained experience? The experiment with 20 students in the course in miniature geometry indicated that the answer to both questions is "yes."

The machine whizzed one man through the course in 33 minutes, and spent 78 minutes making certain that another fellow mastered it. The average time per student was 53 minutes.

President Stratton's Report

IN HIS report to the Corporation this fall, President Julius A. Stratton, '23, described how trends of the day, including increased expenditures for research, are being turned to the advantage of education at M.I.T. The report (copies of which will be sent to many Alumni) dealt also with the state of the social sciences at the Institute, recalled the "magnificent success" of the Centennial celebration, and praised the hard and effective work that Alumni are doing for the Second Century Fund.

The Institute, Dr. Stratton pointed out, has two categories of research programs: Those completely interwoven with its educational objectives, and some undertaken primarily to fulfill its obligations to the nation. The latter as well as the former, however, are contributing to advances in basic science, fundamental engineering, and education; and the relations between so-called "defense" laboratories and M.I.T.'s academic departments and interdisciplinary centers are both cordial and beneficial.

Expenditures for departmental and interdepartmental research have risen more than educational expenditures in the last five years, but teachers and students have constituted an increasing percentage of the personnel engaged in such research. Graduate student enrollment has risen, partly on this account, and undergraduates as well as graduates are now using the large computer and other facilities of M.I.T. research laboratories.

In addition to the Institute's unremitting effort to increase participation of students in significant research programs, it is now engaged in a major program to stimulate improvements in undergraduate teaching. Some departments are experimenting with a tutorial approach this year, and numerous new aids, including take-home laboratory kits for electrical engineering students, are being introduced. Some such innovations have been described in previous issues of The Review, and more will be covered in future issues.

In many quarters, Dr. Stratton noted in his report, concern has been expressed lest the current support of science result in starvation of the arts and humanities. But it is questionable, he observed, whether "the cause of the arts would be advanced by imposing limits on the progress of science," or to argue "that money now expended for physics, biology and mathematics would otherwise fall like manna upon college departments of history, philosophy and literature." Instead, he continued, "the example of the sciences ought to set new measures and standards of public and private support in every field of learning."

Technology Square Progresses

GROUND was broken this fall for the first building in the Cambridge area that is being developed as Technology Square by M.I.T. and the Cabot, Cabot & Forbes Company. Two floors of this building will be occupied by an industrial and electronic data-processing firm called C-E-I-R, Inc., which has its headquarters in Washington. It expects to install equipment worth $15.7 million dollars, including a STRETCH computer, and operate the world's largest and most powerful commercial electronic computing center for both industrial and academic users.

Arthur and Ruth Sloan's Gift

A NEW PROFESSORSHIP in political science, with emphasis on African studies, has been endowed by a gift of $500,000 from Dr. and Mrs. Arthur W. Sloan of Washington, D.C. It is the first fully endowed professorship in the M.I.T. School of Humanities and Social Science, and its holder will work closely with the Center for International Studies.

Mrs. Sloan, who has a doctorate in history from Western Reserve University, is president and director of Ruth Sloan Associates, a foundation specializing in African affairs. She has served for several years as a member of the Department of State and as director of the African program of the United States Information Agency.

Dr. A. W. Sloan, a chemist educated at the University of Illinois and Harvard, is chairman of the Board and executive vice-president of the Atlantic Research Corporation, of Alexandria, Va. During World War II he served as requirements officer for the Foreign Economic Administration in Egypt and later was science adviser to the Joint Chiefs of Staff of the Department of Defense.

The Arthur and Ruth Sloan Professorship is one of eight sought under the Second Century Fund.

The Electric Train's New Rival

THIS CHRISTMAS you can assure yourself some fun by getting an electronic digital computer for your son. The Minivac 601 being marketed by a group of M.I.T. Alumni costs less than $100, and will really razzle-dazzle the neighbors.

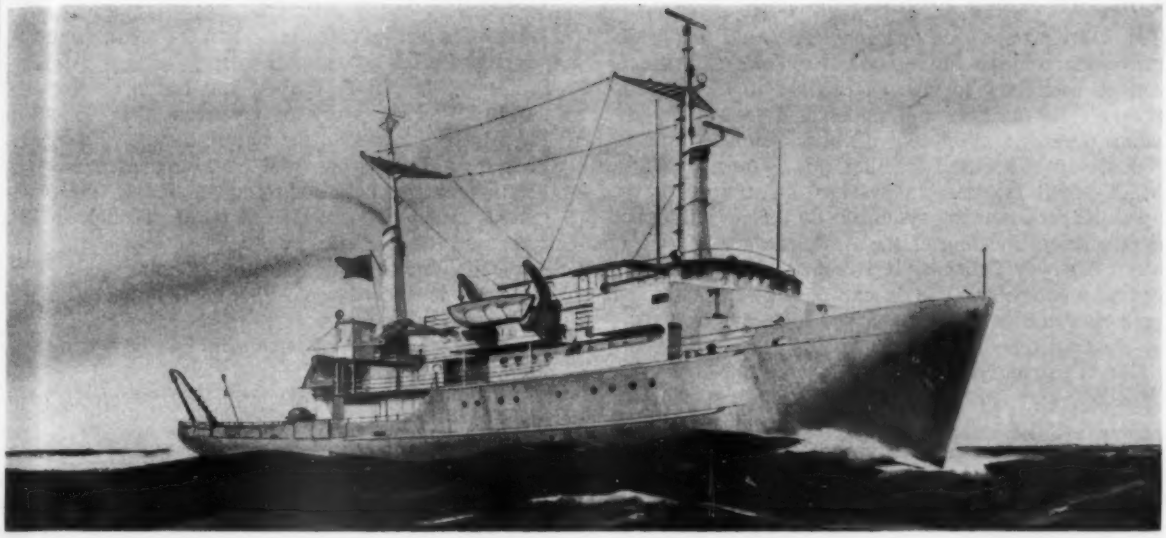
With it and a little patience, you can do the same things that are done with big computers—and in the same way. It may take you an hour to wire the machine to add six and seven, but seeing a binary 13 flash at you in red lights is no small thrill.

The Minivac is a two-foot long box containing a transformer (to reduce 110 volts to 12) and an electric motor (to turn a dial in some experiments). On its surface it has an array of lights, relays, slide switches, push buttons, and 376 holes into which you plug colored wires. Booklets that come with the machine tell you how to hook up flip-flops, convert decimal to binary numbers, use Boolean algebra, play the match game with the machine, and so on and on.

Based on a suggestion of Claude E. Shannon, '40, Donner Professor of Science at M.I.T., it is being marketed by the Scientific Development Corporation in Watertown, Mass. Arnold E. Amstutz, '58, heads the company and his associates include Willard W. Dickerson, Jr., '58, and Raymond E. Jackson, '58. They hope to go on, now that Minivac has been launched, and produce other educational aids.

Professor Phillips Is 80

FORMER colleagues and students of Professor Henry Bayard Phillips, a member of the M.I.T. Department of Mathematics for 40 years, met on September 27 at the American Academy of Arts and Sciences to honor him on his 80th birthday. Professor W. T. Martin was the toastmaster and the speakers included President Julius A. Stratton, '23. Professor Phillips responded with a succinct summary of his career at the Institute and a statement of his philosophy of life, which ended with an optimistic prediction of progress in the future.



A NEW RESEARCH SHIP, to be called Atlantis II, is being built for the Woods Hole Oceanographic Institution. It will be a 210-foot vessel, paid for by the National Science Foundation, and one of the few ships specifically designed and built in this country for oceanography. It will have a bulbous bow containing six glass windows for underwater observations, and four laboratories, including one below decks at the center of least motion for gravity measurements.

Flotation of Micro-organisms

AN IMPORTANT TECHNIQUE of the mineral and chemical engineer, flotation, may also prove helpful in the future to the biologist and food-processing engineer.

Antoine M. Gaudin, Richards Professor of Mineral Engineering at M.I.T., pointed this out in Denver on September 18 when the Society of Mining Engineers celebrated the 50th anniversary of froth flotation in the United States. Professor Gaudin reported the findings in work done under contract with the U.S. Army Chemical Corps at M.I.T., which indicated that micro-organisms could be separated by differential flotation.

In experiments with cultures of *escherichia coli*—a readily available, hydrophilic, nontoxic organism, which would not float—it was found that by adding salt to the concentration the number of organisms in the tailing from flotation could be reduced to the vanishing point. And in experiments with another micro-organism, the researchers found that its spores could be separated from the vegetative cells of the same organism by flotation. They succeeded, too, in floating a contaminant from a mixture of organisms of this type. Hence, Professor Gaudin suggested, flotation may be helpful in such projects as the treatment of soils to isolate various strains of antibiotic-producing organisms.

Ore pulps are commonly described in terms of the percentage of the pulp that is fine enough to pass through a 200-mesh sieve. The micro-organisms with which Professor Gaudin has been dealing could pass through a 20,000-mesh sieve, and are so light that their settling velocity in a liquid is vanishingly slow. They are, moreover, living, reproducing and dying things, rather than inanimate particles, which makes the striking of a balance of materials very difficult. Nevertheless, the experiments showed, they can be floated from one another, or concentrated in a portion of the aqueous phase, and the operation can be both simple and rapid.

Guidance for Apollo

THE National Aeronautics and Space Administration has given M.I.T.'s Instrumentation Laboratory responsibility for developing the equipment that will guide and navigate this country's first manned spaceship to a landing on the moon and during a return voyage to the earth. The laboratory, a teaching-and-research facility under the Institute's Department of Aeronautics and Astronautics, will design and build the first several systems for which NASA will choose a contractor. First-year development costs at M.I.T. are estimated at $4,000,000.

This country's effort to carry out manned exploration of the moon is being conducted under NASA's Project Apollo and selection of the Instrumentation Laboratory to develop the guidance-navigation system made M.I.T. the first member of the Apollo contractor team. The Instrumentation Laboratory has been doing theoretical guidance-navigation studies on a moon flight for NASA since February, 1961.

Charles S. Draper, '26, the laboratory's head, often is called the father of inertial guidance. Roger B. Woodbury, '48, and Forrest E. Houston, '48, associate directors, have supervisory responsibility for several of the laboratory's research programs, including the Apollo guidance work. Development of the Apollo guidance-navigation system is expected to take several years and will be supervised by Milton B. Trageser, '51, Ralph R. Ragan, '52, and John W. Hursh.

Lincoln Decennial Lectures

TO OBSERVE its 10th anniversary, Lincoln Laboratory has arranged a series of lectures on "The Age of Electronics" in M.I.T.'s Kresge Auditorium. The speakers will include Professor H. B. G. Casimir, November 15, discussing important pioneers in electronics; Ivan A. Getting, '33, November 28, on radar; and L. V. Berkner, December 11, on communications.

Computer-Aided Engineering

THE SAME WORDS that one engineer would use to describe the solution of a problem to another engineer can be used now to give instructions to digital computers. The machine will understand *locate, inverse, adjust, intersect, ramp, alignment,* and similar terms.

Professor Charles L. Miller, '51, Director of the M.I.T. Civil Engineering Systems Laboratory, developed the programming system to do this and described it at a recent meeting of the American Association of State Highway Officials. It is called COGO (for coordinate geometry) and is expected to increase civil engineers' use of computers.

The primitive or pseudo languages previously needed to instruct machines made their use time-consuming and costly for problems that are rarely exactly alike. With COGO, it is technically and economically feasible to write a separate and unique program for each set of data, use a program once, and discard it.

COGO already is in daily use at the Institute, and has made it feasible to give students full-scale engineering problems as homework assignments. It also is being employed in the Puerto Rico Department of Public Works, and a specially designed COGO system will be used with the new engineering computer that the Massachusetts Department of Public Works is installing. Professor Miller considers it one step in the development of a much larger system. The Civil Engineering Systems Laboratory is interested in attaching a drafting machine to a computer, and COGO can be expanded to include the words an engineer would use to communicate with a draftsman. Thus engineers ultimately may be freed from such routine chores and enabled to devote more of their time to the creative work for which they are professionally trained.

CHIEF DEVELOPER of an English-like computer language called AUTOPROMT was Samuel M. Matsa, '56 (right, above) of IBM, who is pictured with P. H. Sterbenz. AUTOPROMT was designed to broaden the use of numerically controlled machine tools by leaving to a computer the task of generating tool paths on the basis of a simple description of the part to be milled and the tool to be used. John G. Lee, '21, of United Aircraft Corporation, also participated in its first public demonstration last summer.

Computer-Aided Editing

TIME often can be saved in updating a manuscript to be printed by using a computer to "edit" a tape, Associate Professor Michael P. Barnett and Kalon L. Kelley of the M.I.T. Laboratory of Chemical and Solid-State Physics have found. In the system they have devised, a Photon machine is operated by a tape prepared on a Flexowriter. But before this tape is fed to the photographic typesetting machine, it is run through an IBM computer.

Last-minute alterations in the tape are made by the computer in accordance with directions given to it in such simple English as:

Insert "other" before "document" in the first sentence of the second paragraph.

Start a new paragraph with the fourth sentence of the second paragraph.

The computer can decode these instructions by means of programs called Shadow subroutines, which have been used extensively in work on other problems. The tape that goes to the Photon machine thus can be altered very swiftly, and a Photon machine driven by a tape can turn out work faster than when operated from a keyboard. The developers of the system believe that much retyping can be eliminated and time saved in preparing new editions of manuals, catalogues, and other works that must be revised frequently.

Professor Barnett, whose work has been mainly in theoretical chemistry, operations research, and computer languages, came to this country from England in 1957 and to M.I.T. in 1958. Mr. Kelley, who came to the Institute from Harvard, designed the computer programs for the system. Although they developed it primarily for their own use, they expect wider application to be found for their system.

Biochemists in Moscow

M.I.T. SCIENTISTS who participated in the International Congress on Biochemistry last summer in Moscow included Vernon M. Ingram, who described his method of studying hemoglobin, and Gene M. Brown, who explained how sulfa drugs combat infections in humans.

Hemoglobin, a concentrated protein solution in blood cells, takes oxygen from the air and gives it to areas of the body where energy must be produced. Fetal hemoglobin has properties which allow it to utilize oxygen from the maternal hemoglobin. This form decreases after birth and production of adult hemoglobin begins. But from time to time mutations occur which may have serious consequences. Dr. Ingram and his colleagues have been able to study the switch from fetal to adult hemoglobin by a process known as fingerprinting of molecules, and thus to make certain that the necessary amino acids are present in the correct sequence and amounts.

The sulfonamides, which Dr. Brown discussed, have been used for 20 years, but the mechanism of their inhibitory actions has not been understood. Dr. Brown reported that they "fool" enzymes involved in the biosynthesis of folic acid. Para-aminobenzoic acid is usually incorporated into the more complex folic acid. But the chemical properties of sulfonamides are so similar to those of para-aminobenzoic acid that the enzymes use them in place of the acid, and this reduces the chances of bacterial growth.

(Trend of Affairs is continued on page 50)

Will Your Son Get into College?

You can help by sharing a child's quest for knowledge, but you are not likely to view him the way the admissions officer will

BY EUGENE S. WILSON

NOT LONG ago, the head of a large testing agency told college-educated parents of college-bound students: "Enough is now known about evaluating individual abilities and achievements so that any parent who really wants to may view his child as the child will be viewed by the college."

Now this advice seems to be sound and simple. After all, you do receive regular reports from schools on your child's achievement in each subject. National agencies which offer standardized tests provide with the individual test results a manual of interpretation, so that you may know not only your child's scores, but how these compare with state or national groups of students.

You and your child can also discover through material in the school guidance office information on the range of test scores in freshman classes at many colleges.

AS DIRECTOR OF ADMISSIONS *at Amherst, Eugene S. Wilson (right) has become an outstanding authority on preparation for college. He had 10 years' business experience and was Amherst's alumni secretary before assuming his present post, and has since served as president of the Association of College Admissions Counsellors. This article will be published in many alumni publications this year; Editorial Projects for Education, Inc., holds the copyright and reserves all rights to it.*

In spite of all this information, *you can't think as an Admission Committee thinks, you can't outguess an Admission Committee, and if you try you may expose your child and yourself to disappointment.*

This counsel to think as an Admission Committee thinks reminds me of the advice I received once in a deer hunting lodge on the night before the opening of the deer season, when a veteran deer hunter explained to me that "the way to get a deer is to think like a deer." His elaboration of this philosophy was so convincing that I asked and received permission to hunt with him the next day. What a time we had! He studied the wind, the ground, the trails, and then he explained to me how with such weather conditions the deer would probably do this. He stationed me on one old log and he went in another direction.

To make a long story short, I heard a lot of shooting around me;

The Duty of the M.I.T. Admissions Office . . . As Seen by Its Director

MR. WILSON *emphasizes a highly significant point when he says "no one knows which colleges are best." If there were good objective standards for determining which colleges are best, we are sure M.I.T. would be near the top of the list. But there are no useful standards of this sort, and it is doubtless fortunate that there are not. The important question for any college-bound teenager is "what college is best* for him?" *and the criteria by which this question may be answered are highly subjective.*

The college that is "best" for one may be highly unsatisfactory for another. A college with neither name nor fame will provide a better education for some young people than any of the most celebrated colleges in the country.

To bring this generalization a little closer to home:

We are sure that M.I.T. is tops for many boys; and we are equally sure that it is not the place for many others. The primary task of the Admissions Office is to select those who are best situated to profit from what M.I.T. has to offer; and to direct elsewhere those, however able, who seem better adapted to some other educational environment. It is not —it should not be—a question of admitting the "best" students and rejecting the rest. It is—and must be—a question of finding those students who can profit most from the M.I.T. educational process.

Accordingly, our admissions policy is to evaluate extracurricular activities, motivation, special interests, evidences of the inquiring mind, and to select on the basis of what appears to be "mutual compatibility" rather than merely on the basis of academic performance and test scores. We expect to reject some students who will become honors candidates at top-flight colleges; we expect to admit some students who are rejected by colleges generally considered to be less rigorous and less difficult to enter. Our basic objective is to admit those whose combinations of personal characteristics, intellectual potential, and motivation indicate they are most likely to profit from an educational experience at M.I.T.

Roland B. Greeley

Director of Admissions

M.I.T. freshmen register . . .

I saw a few deer killed by other hunters, but the expert and I never saw a deer. Apparently some deer were thinking as humans think.

Four Unknowns

Here are some of the reasons why you can't think as an Admission Committee thinks:

¶ Admission Committees act differently each year according to the quantity and "quality" of applicants and the needs of the institutions involved. The ever-swelling host of candidates has brought rapid changes in admission standards at every institution.

¶ The weight given marks and test scores varies so much among institutions that even veteran school counselors hesitate to make firm predictions on individual cases. I have heard admission officers for Yale, Wellesley, and Harvard state that test scores do not have the importance they once had in selection procedures. The reason is that at the most popular institutions too many candidates look alike when measured by either marks or test scores.

¶ You can't know from year to year how much weight Admission Committees will give to certain other factors: that is, school and geographical distribution, extracurricular achievement in art, music, drama, sports or community service, and occupational choice (some institutions limit the number in a class who want medicine, engineering, math, or science).

¶ You may be able to understand the strengths and weaknesses of your college-bound child, but you can't know the quantity and quality of the other candidates at the college chosen by your child. At co-educational colleges girls often meet higher competitive admissions standards than boys—and within a university some schools have higher entrance requirements than others.

Whether your child is accepted or rejected at any college depends not only on his credentials, but even more on how his credentials compare with those of the other applicants.

What then can you do when you want to help your child prepare for college—when you want to guide your child to an institution that will stimulate him fully? There is only one safe workable program regardless of your child's test scores, his marks, or his other achievements. This is a program that introduces your child to the mysteries of the world and to the excitement of discovery. This program should be started as soon as your child begins to talk and read.

. . . establish their identity . . .

Most children are born with a full measure of curiosity. They want to know what is going on about them and, as you know, the early years are filled with "What?" and "Why?" and "Where?"

If you have the time and the patience to answer these questions, you will nourish this curiosity that is the taproot of all learning. Only the curious learn.

Your child won't be many years old before you will encounter the first question you can't answer. You can shrug your shoulders and say, "Go away and stop bothering me," or "I don't know," or "Let's find out."

If you have the time and patience to lead your child in his probe of the unknown, in his search for knowledge, you will encourage the maintenance of a habit of inquiry. You may also rediscover for yourself the fun of learning.

But this nourishment of curiosity means that a mother cannot be too occupied with community affairs, social teas, or bridge parties, and that on some mornings she may have to leave the beds unmade or the dishes unwashed until nap time, and Dad may have to miss a golf game. Priorities must be established.

Today there are so many forces working against the development and maintenance of curiosity in a child, forces like the radio, television, the automobile, and hundreds of sporting events. All too often curiosity is throttled by spectatoritis, by parents who are too busy, and even, alas, by the rigidities of the school system and the desire of teachers to cover a certain amount of material so that students will do well on their tests.

If you want to help your child get into a college, you will always be aware of what your child is studying in school and especially what he is reading. *Your reading will supplement his reading and your learning will mesh with his so that you will be in a position to stimulate his fur-*

(Continued on page 58)

. . . and start up the steps.

A Magnetic Record For the Time Being

126,000-gauss continuous field is attained in old laboratory

A NEW RECORD—for the M.I.T. National Magnet Laboratory to eclipse—was set last summer with a solenoid magnet invented and patented by Henry H. Kolm, '50. Using the power and water available in the basement of Building 4, it produced a continuous magnetic field of 126,000 gauss.

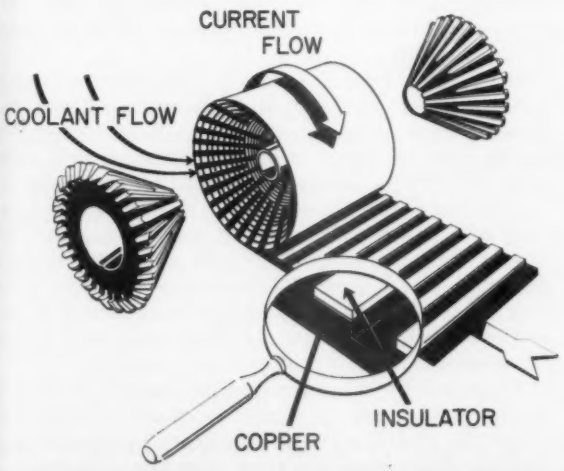
This is about six times the strength of similar fields obtained with big iron magnets, and exceeds by about 25 per cent the strength of the continuous fields that Professor Francis Bitter attained in the 1930's.

Five times as much power will be available in the new laboratory that is now being constructed as has been in Professor Bitter's Building 4 laboratory, and a magnet now being developed is expected to produce a continuous field of 250,000 gauss.

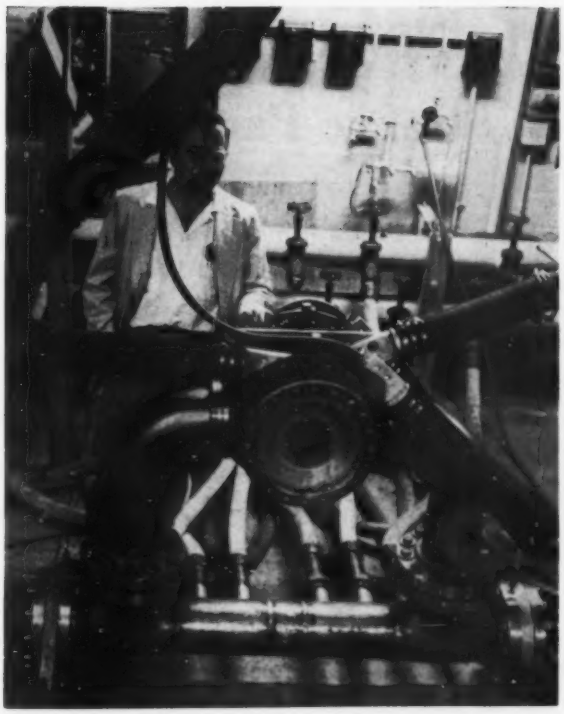
Much higher pulsed fields have been created. Dr. Kolm and Simon Foner of Lincoln Laboratory, for example, produced pulsed fields of 750,000 gauss about five years ago. But such fields last only for microseconds.

Professor Bitter recently described how the first great continuous fields were generated at M.I.T. in a booklet for high school students, *Magnets, The Education of a Physicist* (Doubleday Anchor, 95 cents). "The first and main difficulty," he pointed out, ". . . is that strong enough currents tend to heat the coil, melt it, squeeze it out of shape, and destroy it."

Dr. Kolm has overcome this difficulty in a new way. His solenoid consists mainly of a 135-foot-long copper ribbon, tapered from a width of six inches at one end to a width of only an inch and a half at the other end. This ribbon is wound between insulating material like the sweet part of a jelly roll, but with vastly more care.



Water flows through the slots while current flows through tapered copper ribbon which constitutes the Kolm magnet.



Henry H. Kolm, '50, with the new magnet (shown on the cover) as it appears when it is mounted to be powered.

There are more than 3,000 slots in this ribbon, and they are cut so that when it is wound they are aligned like the spokes of a wheel. These slots provide channels through which water is pumped to cool the coil. You can see light through it when it is removed from its mounting, and when it is operating 320 gallons of water are pumped through these fine channels every minute. During Dr. Kolm's recent experiments with it, this water removed the heat produced by the consumption of 1,880,000 watts of electricity.

The first two coils he tried were half-scale models made by hand, and served mainly to test the design concept under realistic conditions. To produce the coil which set a new record, the High Voltage Engineering Corporation designed special machinery.

The whole solenoid is about the size of a grapefruit and the 126,000-gauss field is produced in an aperture about an inch in diameter and two inches long in the center of the coil. This is about the size of the continuous fields Professor Bitter's apparatus produced before World War II interrupted his efforts to generate still stronger fields. The volume requirements are modest in solid-state and much other research, but both stronger and larger fields will be made available in the future.

Work on the Kolm solenoid began in the Solid State Physics Division of Lincoln Laboratory and has been continued in co-operation with the National Magnet Laboratory with the support of the Air Force Office of Scientific Research.

The powerful continuous fields that Drs. Kolm, Bitter, and others at M.I.T. are now planning are expected to facilitate the study of materials, superconductivity, and fusion power, and be helpful in efforts to improve devices ranging from microscopes to space vehicles.

The New Detectors of Strange Particles

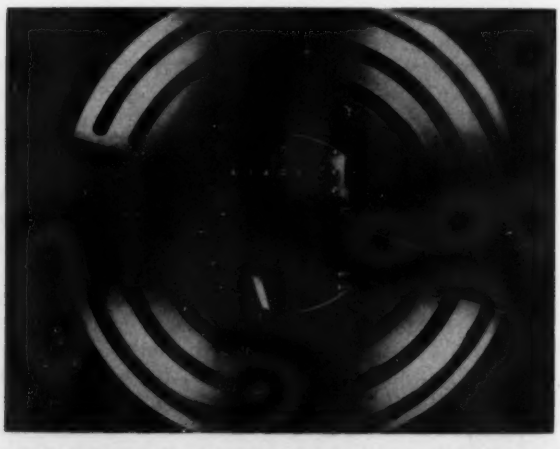
Even neutrinos are being sought with the help of spark chambers

WITH both of the world's two most powerful accelerators of atomic particles, efforts are about to be made to detect neutrinos. A neutrino is so nearly nothing that it can go right through the center of the earth without being stopped; its mass is all associated with its energy and would be zero if the neutrino were halted, but a neutrino can never be brought to rest. Physicists hope, nevertheless, to verify the existence of neutrinos and study them in the beams from the multibillion volt accelerators at Brookhaven National Laboratory and the CERN laboratory in Switzerland.

A new detecting device called the pulsed spark chamber will be used in these and many other experiments now planned with the big accelerators. The first pulsed spark chamber in the Western Hemisphere was built in the M.I.T. Laboratory for Nuclear Science by Dr. David A. Hill, '54, and Michael A. Wahlig, a graduate student, in 1958. This one still is being used almost daily, and additional chambers have since been built in Professor David Frisch's laboratory and elsewhere.

The core of a pulsed spark chamber is a set of metal plates with gaps between them. These plates are electrically charged when a trigger is touched, and sparks fly between the plates when a subnuclear particle has gone through the chamber in which they are housed.

The trigger of the first chamber produced at M.I.T. is a plastic disk that is sensitive to debris from cosmic radiation. There is a scintillation in this plastic whenever a meson or some other invisible, charged, energetic particle comes along. This scintillation notifies the instrument that something is plunging through its plates.



The sparks in this cylindrical chamber (and their reflections in a mirror) follow the path taken by a K meson going downward and leftward after striking a proton in the center and sending it upward to the left.

A strong electric field is then created in the gaps between those plates, and sparks cross the gaps. Those sparks reveal the points at which that "something" has ionized the gas between the plates. The sparks can be photographed, and thus the path taken by the invisible something can be determined.

Such a chamber can be set up so that it will be triggered only by certain things, and this is what makes a pulsed spark chamber so useful to a physicist. With it he can locate particular kinds of elementary particles in beams that contain many different kinds.

When bubble or cloud chambers are used to detect subnuclear particles, hundreds of pictures—cluttered with traces of a great assortment of things—often must be examined to find the pathway of some particular, short-lived particle. Bubble and cloud chambers will continue to be used in many experiments, but in others the new spark chambers will save the physicists a great deal of time and work.

The new chambers vary both in size and design. The plates of M.I.T.'s first one are flat and about the size of 45-rpm phonograph records. These are stacked in a gas-filled, glass box about a foot high. A mirror alongside the chamber enables an observer peering into this box to see both the sparks and reflections of them. The mirror also makes it possible to take photos from which the particles' paths can be charted in three dimensions.

Spark chambers with cylindrical rather than flat plates also have been built. These resemble nests of metal cans, with a little one in the center and progressively larger cans around it. When you look into the end of a cylindrical spark chamber, the edges of the plates may remind you of the rings in a tree trunk. By placing a camera at one end of such a chamber and a mirror at the other end, stereoscopic records of the sparks between the cans can be obtained.

The spark chamber that a Columbia University group will use in the effort to detect neutrinos at Brookhaven will weigh 10 tons. Its size and that of associated apparatus and shielding has prompted one of the accelerator's operators to predict that, if the world ever disarms, no one will have to worry about what to do with old battleships and guns because, by then, the physicists will have thought up uses for all of the tons of metal in them.

M.I.T. men have a relatively light spark chamber set up at Brookhaven already, for work with K mesons. Research such as this is called "parasiting," because it can be done incidental to and simultaneous with such higher priority projects as trying to detect neutrinos.

The K mesons are particles with about 970 times the mass of electrons. They can be positive, negative, or neutral, and the latter kind have especially strange properties. The K mesons decay in more different ways than the other elementary particles discovered in the last few decades, and these decay processes yield pi and mu mesons, electrons, positrons, and neutrinos.

To fit the K's into the physicists' concept of nuclear forces neatly, more knowledge is needed of their behavior. By placing a trigger on a spark chamber to distinguish certain K mesons from other things, the M.I.T. researchers at Brookhaven hope to obtain photographs from which they can draw enlightening information.

The Wingerson Corkscrew Effect

It suggests a way to remove an obstacle to thermonuclear power, and a new kind of experimental magnetic bottle is being built

A NEW KIND of magnetic bottle incorporating a corkscrew-shaped field is being built this fall at M.I.T. to test a newly suggested way of removing a major obstacle to harnessing thermonuclear energy. Proposed by a graduate student, Air Force Captain Richard C. Wingerson, '52, it is being built by another graduate student, James S. Tulenko, under the supervision of David J. Rose, '50, Professor of Nuclear Engineering. Professor Rose believes that Captain Wingerson has found a solution to a problem with which many men have struggled in vain.

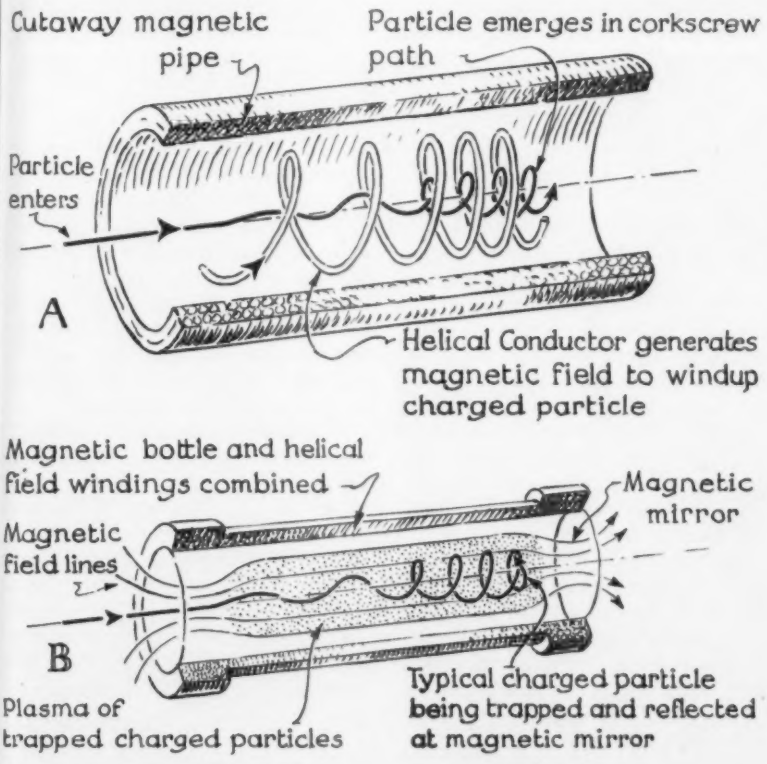
Thermonuclear reactions occur between the nuclei of isotopes of hydrogen at extremely high temperatures. In the sun and stars, gravity confines this material, which physicists call plasma; on earth confinement can be achieved only by magnetic fields. Magnetic containers of various shapes are being studied, but the better the container is, the harder it is to put the plasma inside.

One important class of bottle consists of a long pipe, the walls of which are a magnetic field created by an electrical coil around it. The ends of this pipe are open but "mirror" magnetic fields are set up there to serve as stoppers. Captain Wingerson has found a way of filling the bottle with plasma, by using corkscrew magnetic fields. This structure, his work indicates, would be much more effective than configurations proposed hitherto—for example, an undulating field investigated two years ago by the Soviet physicist, K. D. Sinel'nikov.

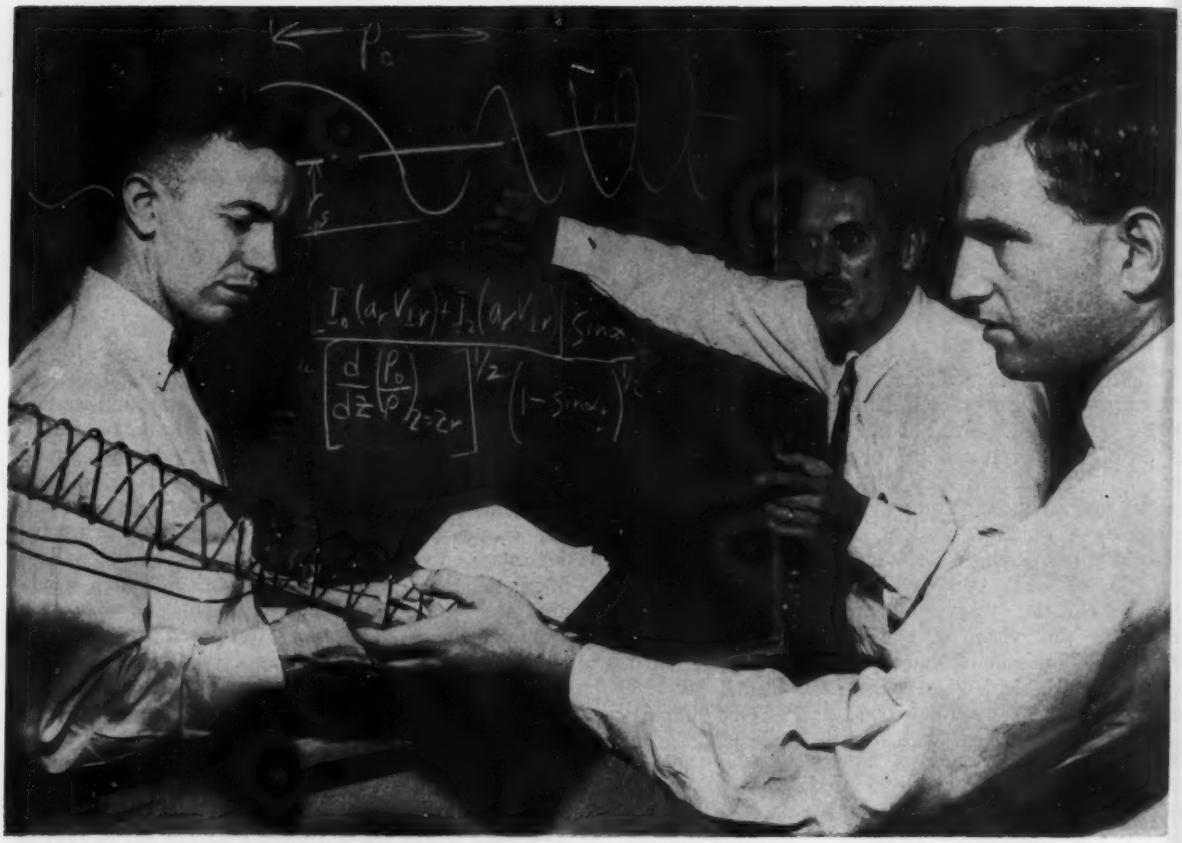
By making this field spiral like a drill, Captain Wingerson's computations show that a beam of particles shot into the tube along its axis with a certain energy can be wound up or unwound. In other words, some of the particles' longitudinal energy can be transformed into perpendicular energy. The mirrors are then more effective, and enough particles can be retained in the tube for sufficient time for energy to be released by their fusion.

In effect, his device would be similar to a lobster trap. It would be easy for a particle to get into the thing but difficult for it to escape because of the trap's geometrical configuration. The walls of this trap are the complex magnetic fields created by the axial coil and the mirrors—and the entrance to the trap is determined by the corkscrew fields.

Theoretical studies made by Captain Wingerson have reached a point where definite predictions of the behavior of charged particles in the corkscrew structure have been made, and designs for a major experiment are under way. The ionic charged particles that must be confined for a thermonuclear reaction to occur are relatively heavy, and would necessitate a structure between 50 and 100 feet long. The experimental scale model being


Cutaway magnetic pipe
Particle emerges in corkscrew path
Particle enters
A
Helical Conductor generates magnetic field to windup charged particle
Magnetic bottle and helical field windings combined
Magnetic mirror
Magnetic field lines
B
Typical charged particle being trapped and reflected at magnetic mirror
Plasma of trapped charged particles

How Wingerson's magnetic "corkscrew" operates: In upper picture (A), the helical wire generates a magnetic field in the magnetic pipe to wind up an entering particle. Below (B), the corkscrew has been combined with a magnetic bottle to trap high-energy particles and form a plasma.



Captain Wingerson, Professor Rose, and James S. Tulenko (left to right) discussing a new design for a magnetic container.

built by Mr. Tulenko will operate with electrons, which are much lighter than the ions. As a result, this scale model will have to be only eight feet long.

Large-scale experimental machines of many types have already been built in this country, England, and Russia, in the hope of achieving thermonuclear reactions. The plasmologists at M.I.T., however, have maintained that the first step should be to acquire more fundamental knowledge of the nature of plasmas, their instabilities, and their behavior in magnetic fields. This basic research has led to the discovery at M.I.T. of the Wingerson corkscrew effect and many other important plasma phenomena. Such studies will be extended with Mr. Tulenko's scale model while other graduate students are dealing with other aspects of thermonuclear problems.

Captain Wingerson returned to the Institute two years ago to resume his studies, and met the requirements for a doctorate much sooner than is customary. The idea that will now be tested is set forth in his doctoral thesis. He left M.I.T. this fall to become an instructor in the Air Force Graduate School at Wright Field.

Preliminary research inspired by Captain Wingerson's discovery already is under way in the Atomic Energy Commission's Los Alamos Scientific Laboratory, and was described in September at an international conference on plasma physics and controlled nuclear fusion research in Salzburg, Austria. M.I.T. was represented at that conference by Professors William P. Allis, '23, Sanborn C. Brown, '44, and George Bekefi.

The eight-foot scale model now under construction will be only one step in the development of an eventual thermonuclear power plant. Professor Rose envisions the ultimate creation of a machine in which for reasons of economy huge magnetic fields will be created by superconducting coils operating at temperatures near absolute zero. Captain Wingerson's configuration would be incorporated in the superconducting field structure.

These fields would confine a plasma whose temperature much exceeds that in the middle of the sun, and the resulting thermonuclear reaction would be harnessed to yield hundreds of millions of watts of electrical power. It is the temperature difference of a billion degrees within a single piece of apparatus that requires the use of magnetic walls instead of material ones to confine the plasma.

The use of corkscrew magnetic fields for winding or unwinding beams of particles is not limited to thermonuclear devices. Professor Rose believes, for example, that it could lead to improvements in the apparatus now used to inject particles into the great accelerators with which subnuclear matter is examined. Many other applications will undoubtedly be found, Professor Rose believes.

The current work is being done in M.I.T.'s Research Laboratory of Electronics, supported in part by contracts from the Defense Department and the National Science Foundation.

Missile Makers' Instrument Discloses Blood's Behavior

A DEVICE invented in the M.I.T. Instrumentation Laboratory to measure very small torques has been used part time of late by blood researchers and has revealed that blood plasma is a non-Newtonian fluid.

The viscosity of a Newtonian fluid such as water remains the same no matter how swiftly or slowly it flows. That of a non-Newtonian fluid changes (catsup is a familiar example), and the discovery that blood plasma is non-Newtonian may be helpful in dealing with circulatory disorders and cardiovascular disease.

Philip J. Gilinson, Jr., '36, and Charles R. Dauwalter, '55, originally produced the instrument with which this discovery was made in order to aid in the production of inertial guidance systems for great missiles. Several companies producing Polaris guidance systems for the Navy use instruments similar to it now to check the performance of gyroscopes and gyro sub units. It is so sensitive to torque that it can measure the rotational force exerted by a small wheel that turns only once a day.

In missile work, the instrument is called a "torque-to-balance loop." In medical research, it is called the "GDM Viscometer" after its two developers and Edward W. Merrill, '47, Associate Professor of Chemical Engineering. Dr. Merrill's search for an instrument to measure viscosity at extremely low flow rates led him to the Instrumentation Laboratory last winter.

He was collaborating at the time with Dr. Roe E. Wells, Jr., of the Harvard Medical School in the study of chemical and physical properties of blood plasma and plasma containing anticoagulants. Professor Richard H. Frazier, '23, of the M.I.T. Department of Electrical Engineering, helped bring about the merger of missile and medical research which resulted in the GDM Viscometer, and the work was done under a grant from the estate of Alfred H. Caspary, '98, to M.I.T.

Speed adjustments on motor are made to study blood plasma's viscosity.

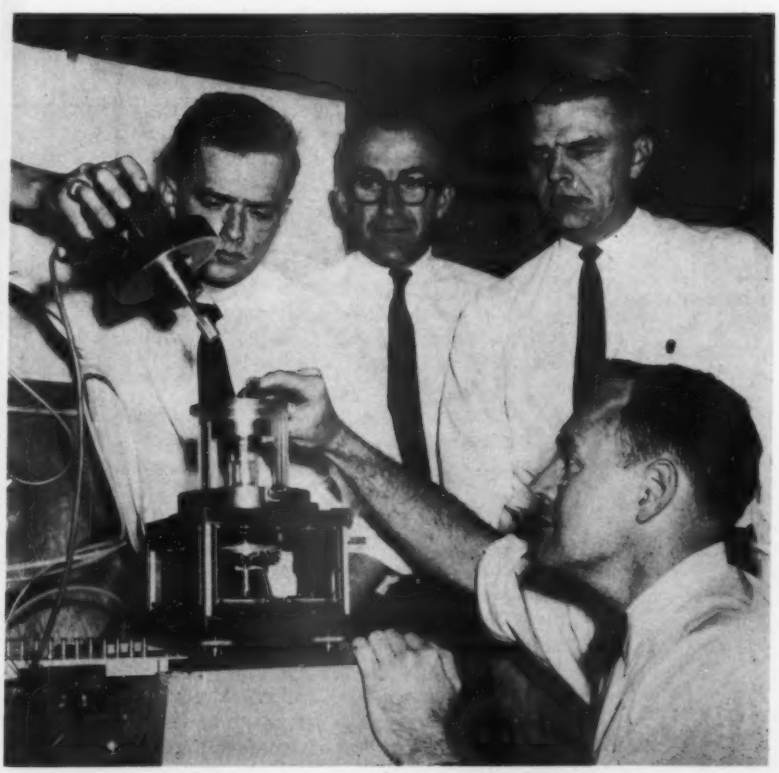
As a viscometer, the device is rigged to a small cup containing the fluid to be tested and a rotor is immersed in the fluid. This rotor exerts shear on the fluid, and a torque on the cup results. The shear rate is known from the motor setting, and the shear stress is found from the torque on the cup, to compute the viscosity of the fluid.

A teaspoon of blood suffices for a test, and it takes less than a minute. Most viscometers require more fluid, and tests take so long that blood sometimes clots. By imparting very tiny shear rates to the fluid and measuring the shear stresses that result with great precision, the GDM Viscometer has made viscosity studies possible at lower ranges of shear rate and shear stress than were previously feasible.

Drs. Merrill and Wells suspected from earlier work that plasma might be non-Newtonian, and succeeded in measuring changes in its viscosity with the Instrumentation Laboratory's extremely sensitive instrument.

Blood plasma's non-Newtonian character, they believe, may account for some of the curious mechanics of its circulation in the capillaries. These tiny blood vessels are about the same diameter as the

(Concluded on page 54)



The GDM Viscometer and its developers (from left to right), Dauwalter, Merrill, and Gilinson of M.I.T., with Dr. Wells of Harvard (in foreground).

This Year's Fastest Computer

Lincoln's FX-1 is 10 times as swift as today's giants and a "working model" for new generation

AGAIN, M.I.T. has the fastest digital computer ever built. In 1951, it was Whirlwind, now it is Lincoln Laboratory's FX-1 .

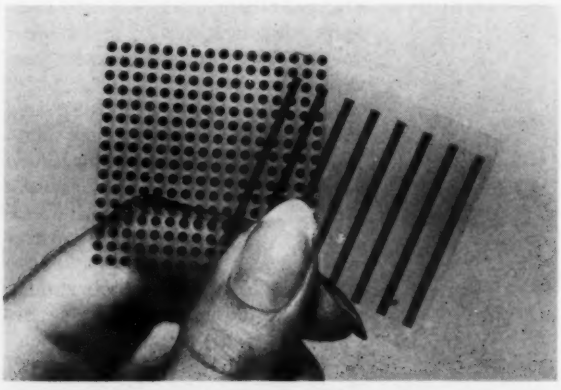
Lincoln Laboratory traces its origins to the Digital Computer Laboratory that grew up around Whirlwind. Its staff has since built a series of larger, faster machines, and regards the FX-1 as "a working model for a new generation of machines" that will be 10 times faster than the computers now in general use.

The FX-1 is a small but complete general-purpose computer. It and its power supplies occupy only three relay racks (pictured on the next page). It operates at room temperatures, is easily ventilated, and requires only one-thirtieth as much power as Whirlwind. But its high speed enables it to match the performance of considerably larger machines.

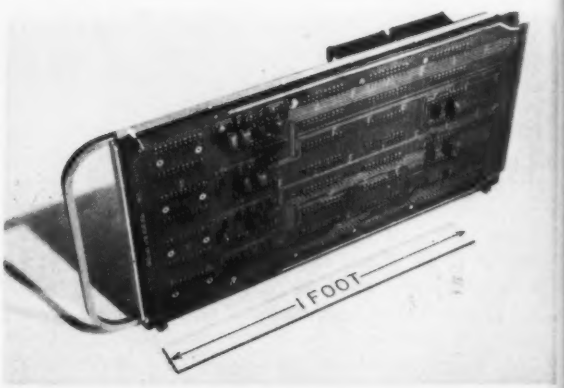
Whirlwind averaged 30,000 operations per second. The TX-2 built by Lincoln in 1958 averaged 120,000. Innovations embodied in the FX-1 enable it to average 2,000,000 per second.

The FX-1 was built for realistic tests of new construction techniques, improvements in transistors and circuitry, and storage of information in thin films of magnetic material. It is expected, however, not only to serve for such tests but also to do some practical work. Its speed makes such a computer especially suitable for pre-processing high-peak-rate data before it is given to other machines.

This machine was carefully designed for high-frequency operation, and is the first one to have a main memory made of thin magnetic film elements. Lincoln has been among the pioneers in the development of such memories to replace ferrite core memories, which were an important earlier M.I.T. contribution to computer technology.



Round dots were first magnetic film memory elements. Rectangular elements are used in Lincoln's FX-1 computer.



Plated-circuit tray in FX-1 holds up to 20 plug-in units, has two layers of wiring on either side of ground plane.

The speed of a computer is limited both by the timing pulses which govern the operation of its logic circuits and the time that is required to remove a word from its memory and write in a new one. In both respects, the FX-1 is faster than today's most advanced commercial computers.

The speed of the logic circuits is called the *clock rate*. Whirlwind's effective clock rate was two million pulses a second; in the TX-2 this rate was increased to five million, and in the FX-1 it has been increased to 50 million. This is four times the rate of the fastest commercial machine disclosed to date.

This high clock rate was achieved with improved transistors, now in commercial production, which were developed under subcontract with the collaboration of Lincoln's Computer Components Group. "Plated-circuit" wiring was developed to simplify and improve the performance of its circuits at high frequencies.

The time needed to take a word out of a computer's memory and put a new one in is called the *read-write cycle time*. Ferrite core memories made it possible to attain a read-write cycle time of 10 microseconds in Whirlwind and cycle times in today's very fast machines that range from 2 to 12 microseconds. The read-write cycle time of the FX-1 is only three-tenths of a microsecond, thanks to the development of thin magnetic film memory elements.

Such elements are made by evaporating or plating magnetic material on a glass plate. In the magnetic film

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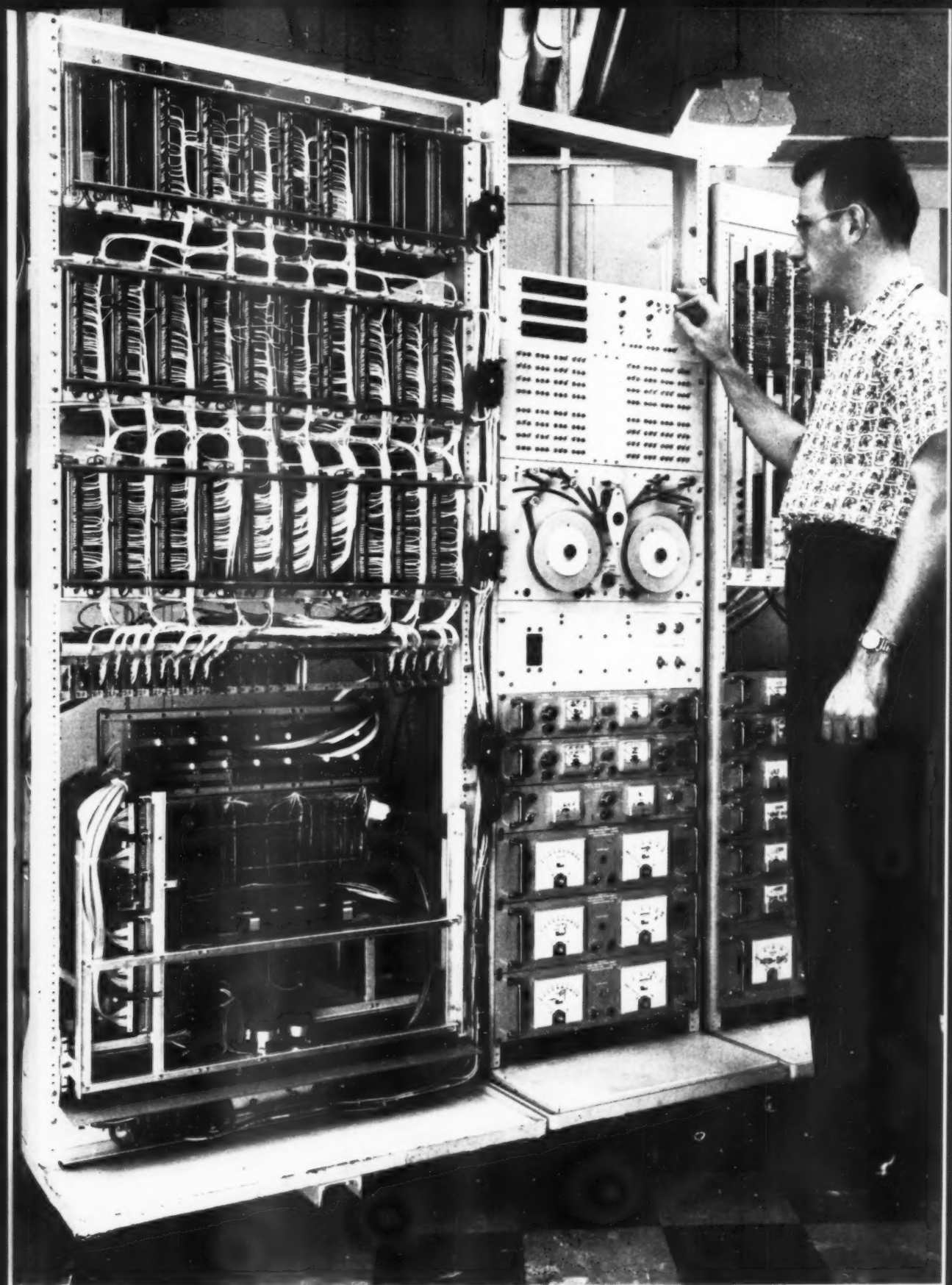
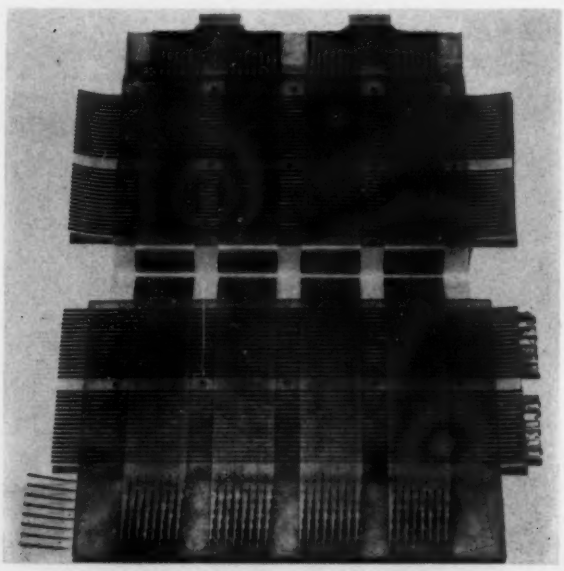


The FX-1's thin magnetic film memory (above) has small bright rectangles (in picture on next page) positioned at intersections of particular pairs of vertical and horizontal conductors on a printed-circuit wiring assembly.

memory that Lincoln added to its TX-2 computer two years ago, these elements were little round dots. In the FX-1, however, the spots are rectangles, and the plates bearing them are placed between printed-circuit wiring on resin-impregnated glass-fiber cloth in such a way that each element rests on the intersection of two perpendicular leads on the writing sheet.



The upper half of this printed-wiring sheet is folded over the plate bearing the thin rectangles of magnetic material.

The packaging of the logic circuits is another distinctive feature of the FX-1. These are in compact plug-in units of 12 standardized basic types. And these units, in turn are mounted in trays that plug into the computer frame. Some of the 13 different types of trays have the plated-circuit wiring (as contrasted to the printed-circuit wiring of the plug-in units) which was designed to have uniform impedance characteristics.

Compared to other computers, the FX-1 is a midget. It contains only 3,000 transistors, whereas one large commercial computer now calls for 200,000. The capacity of FX-1's memory, 3,300 bits at present, is to be quadrupled but still will be small compared to the 2,500,000-bit capacity of the TX-2.

Nevertheless, the FX-1 is clearly ahead in the race for speed and most of the components and construction techniques employed by its builders are regarded at Lincoln as quite conservative. "The fabrication of uniformly good magnetic film memory elements is, at the moment, largely a laboratory process," says William N. Papian, '48, leader of the Lincoln Digital Computers Group. "But with this one possible exception industrial production of computers with comparable performance should offer no serious problem."

Among those associated with Mr. Papian in the FX-1's development were Wesley A. Clark, Jr., '55, Jack L. Mitchell, '57, Jack I. Raffel, '54, and Kenneth H. Konkle, '57. M.I.T. operates Lincoln Laboratory with joint support of the Army, Navy, and Air Force.

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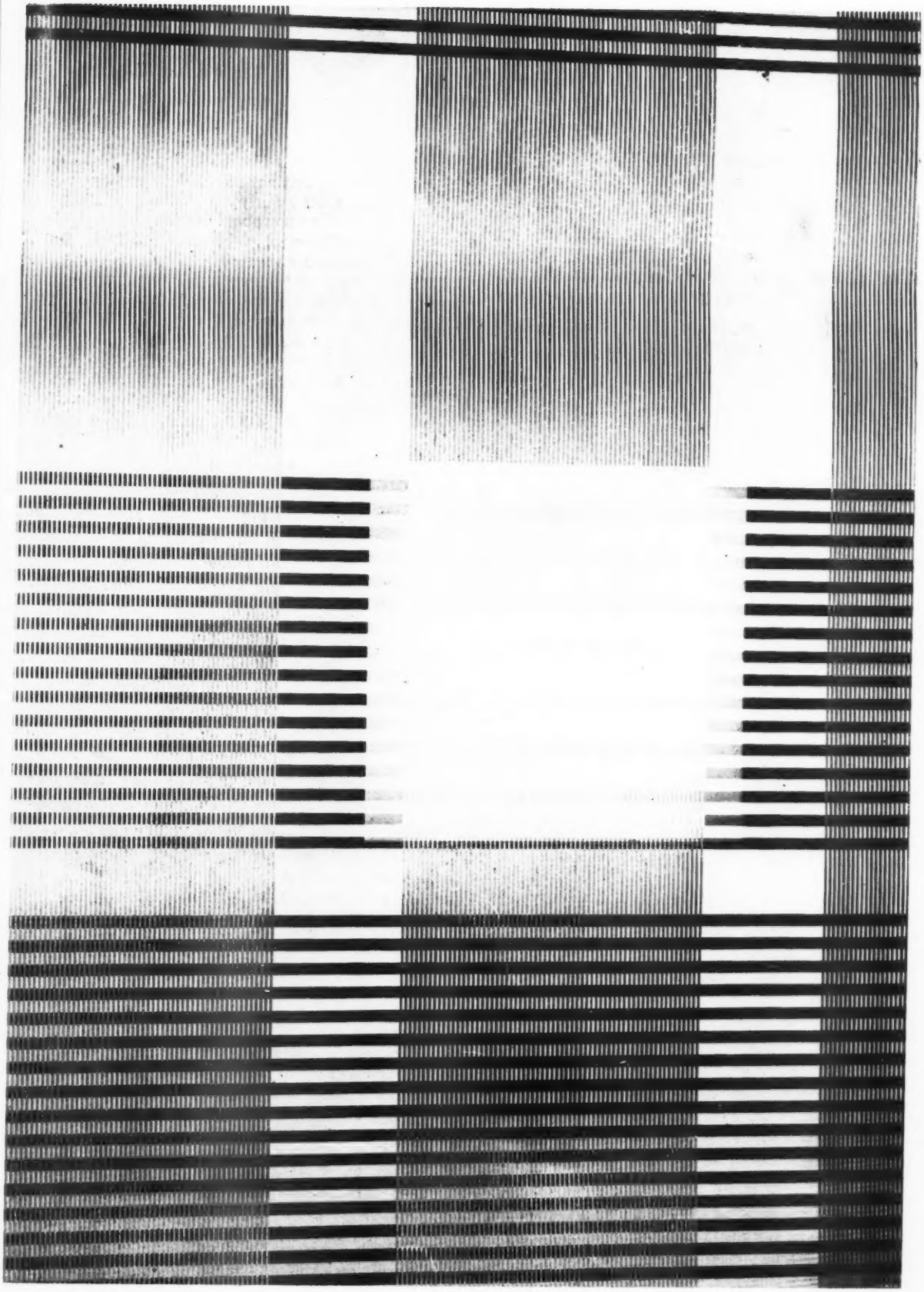


Books

Interesting Unnecessary Remarks

TO ADVERTISE a five-volume HISTORY OF SCIENTIFIC THOUGHT edited by Professor Giorgio D. de Santillana, the University of Chicago Press wrote to him for help. Some of the publisher's questions, and the replies of the M.I.T. Professor of the History and Philosophy of Science, as reported to the press, follow:

Q.—Mr. de Santillana, you have written a book on the origins of scientific thought and are editing a series on its history. Why do you consider this project necessary?

Professor de Santillana

A.—I don't in the least. No book is necessary, save the Good Book. I thought it might possibly be useful.

Q.—Useful, perhaps, in bringing science back in touch with the humanities?

A.—You are opening up an area in which banalities abound, you know.

Q.—Let's try to keep away from them.

A.—Frankly, I don't think a rapprochement between science and humanities is possible at the present. One of the very few ways in which it might be accomplished is to treat science as one of the humanities, which it emphatically is . . .

Q.—Before we proceed further, do you have a personal definition of science?

A.—Why? I suppose Webster's definition is still good.

Q.—To go back to your last answer but one, do you treat science as one of the humanities in your book?

A.—Well, when the series was first conceived, I thought of its purpose as trying to locate the launching ramps of the various ideas and the moment of take-off, then trace the idea to the point of impact in a later period. My "personal" working titles were: "Take Off," "Goof Off," "Ideas in Orbit," and "Nose Cone Revisited." In reply to the question, yes.

Q.—What did you set out to do in "Take Off," or as it is now called, *THE ORIGINS OF SCIENTIFIC THOUGHT: From Anaximander to Proclus—600* B.C. *to 500* A.D.*?*

A.—I wanted to provide the foundation for the series. There is a certain period going from 600 to 300 B.C. which has really provided all the possible approaches, or shall we say the pack of cards that we can play. We can find new games, but the pack is still the same. I have been concerned, therefore, to mark the ways in which the various approaches to science are stated for the first time and explored in many directions. This provides the map on which we can follow the course of thought down into our own times.

Q.—Would you call the series an anthology?

A.—I don't know what I'd call it. The initial plan was to have as much as we could of the original texts with the needed commentary and introduction. It turned out that not much could be done with the texts without a fairly complete presentation, so we will average out at about half and half.

Q.—This technique has been used before. Do you think it has been generally successful?

A.—For the publisher, perhaps, but the public is often cheated because the subject matter is only accessible to the specialist. Our attempt is to show the roots (that word!): to present the fundamental ideas of science as they start and develop from the social and cultural context, without following them beyond a certain degree of complication, the essence being that it must be generally accessible to the educated person, and allow him to use his critical judgment.

Q.—Stylewise (that word!), what audience did you write for?

A.—I have kept in mind the average reader of the *Scientific American*. Remember, the fundamental ideas of science are philosophically profound, often clear, always vital. The technical developments are beyond the common public, and any attempt at vulgarization will always lead to false impressions and a feeling of black magic. Sometimes even scientists do not really know what they are doing, and operate by guess and by God.

Q.—In other words, scientists themselves need a sense of the history of their discipline?

A.—Of course. Too many of them consider history of science as a collection of past mistakes which had better not be dug up. This is what has isolated them from the cultural world and turned some of them into dangerous gadgeting maniacs. Great scientists, however, have always understood what I have been saying and have contributed themselves validly to the philosophical and historical understanding of their discipline. The obvious names come to mind: Einstein, Bohr, Weyl, Poincare, Mach, Heisenberg, Schroedinger, D'Arcy Thompson, Russell, Wiener.

Q.—Any message for budding scientists?

A.—You mean students? Permit me to address myself to teachers as well. As far as education is concerned, it has been realized that one of the few ways of introducing the T-square boys to our planet and its human vicissitudes is to give them the feeling that science sprang from a given context of ideas which are really the whole of a civilization. We have found in fact that one of the few ways to teach history of ideas to M.I.T. students is to weave it around the evolution of scientific concepts. Science is never full blown. It is a hazardous endeavor stretching out perilously over uncharted territory, and an important way of knowing where we are going is to try to understand where we started from.

(Book News is continued on page 60)

Khrushchev's Ticket to Tomorrow

The new program for the Communist Party is a personal triumph and it leaves Lenin's pledge of eventual political freedom unkept

BY HERBERT RITVO

THE DRAFT PROGRAM of the Communist Party of the Soviet Union, published last July 30, is simultaneously an introduction to the forthcoming 20-year plan for economic development of the Soviet Union—and the Sino-Soviet bloc—a review and restatement of Marxist-Leninist theory and practice, a rationalization of current policies, and a guide for future action. As a general program, it is essentially a doctrinal manifesto which marks a new phase of N. S. Khrushchev's personal rule by placing him in the direct line of succession to Lenin as the ideological interpreter and political leader of world Communism.

The first (1903) program of the Party, then the Russian Social Democratic Labor Party, was fulfilled, in the opinion of Party historians, by the Bolshevik seizure of power in 1917. The second (1919) program, drawn up by a committee of seven including Lenin, Bukharin, Zinoviev, Trotsky, and Stalin, was designed to direct the "dictatorship of the proletariat" during the transition period between the capitalist past and the vaguely imminent socialist future. Despite Stalin's liquidation of five members of the drafting committee, this document retained its validity for more than 40 years, but has been totally ignored in Soviet propaganda because of its irrelevance to the reality of the last three decades.

Khrushchev was not even a member of any of the various commissions which sought to revise the second program between 1939 and 1956. But now he has brought forth a document which, for the time being at least, becomes Communist dogma. In view of Stalin's record of abortive attempts to complete the long-delayed overhauling of the Party's doctrinal foundations, Khrushchev's speedy success is an accurate reflection of the consolidation of his personal power and his heightened status as a theoretician. Since Lenin alone is, according to all official Soviet texts, the father of the two previous programs, the identification of Khrushchev with the 1961 draft has endowed him with a distinctive attribute of leadership hitherto monopolized by Lenin.

In the draft program the long campaign, consistently and consciously waged to lift Khrushchev's tactical maneuvers to the level of programmatic principles, has been crowned with total victory. But the new program, however much of its labored rhetoric is eventually transformed into reality, will not be able to cover the scars which Stalinist socialism branded onto its fundamentally humanitarian predecessors.

HERBERT RITVO, research associate in the M.I.T. Center for International Studies, intended to become a biochemist when he entered Harvard in 1932, but soon became absorbed in foreign affairs. After serving in the U.S. Army Counter-Intelligence Corps, he edited a German language publication for the U.S.I.A. and became associated with Radio Free Europe. He has studied the Soviet Union, China, the satellite states, and the world Communist movement for many years, and has written extensively on these subjects.

Persistent Illusions

In the text of the new program one immediately notes the recurrence of ideological stereotypes, the reaffirmation of familiar hopes, and the reiteration of persistent illusions. Despite the passage of 42 years, during which the impotent Imperial Russia of the Tsars was transformed into the mighty Soviet Union of the Commissars, the new program does not mark a new milestone in the development of Communist theory. Denying its real parentage—by failing to acknowledge either Plekhanov (1903) or Bukharin (1919)—the program seeks to mask the illegitimacy of its prerevolutionary birth and its postrevolutionary adolescence behind the father image of V. I. Lenin; similarly, it ignores completely the personal contribution of Stalin to the state's growth to industrial maturity, by attributing his positive works to Lenin. Of the misdeeds of Stalin which Khrushchev condemned in 1956, there is no word in 1961. In its review of the past the new program is hardly more than another rewriting of Soviet history by omission.

Nevertheless, neither the staleness of its philosophy nor the sparsity of long-range economic data in it can obviate the need for us to comprehend the meaning of this program which is destined to offer basic guidance to the world communist movement. At its dogmatic worst in its survey of modern capitalism, the draft stubbornly refuses to come to grips with the failure of Western industrial societies to fulfill the predictions of Marx and Engels or the prophesies of Lenin. Replete with rephrasings of the second program's forecasts of the still impending doom of capitalism, the new document neither offers a meaningful rationalization for the nonappearance of the long-awaited major post-World War II depression nor provides convincing evidence of the constantly invoked "relative and sometimes absolute

deterioration in the position of the working class."

Proclaiming the Khrushchev doctrine of peaceful coexistence, and again denying any "fatal inevitability of war," the program leaves open the possibilities of "peaceful and parliamentary roads to socialism"—but only in the narrowest interpretation predominant since the execution of Imre Nagy in 1958. Pointing out that "Communists have never maintained that . . . the road to revolution runs through wars between countries," the program has none of the frequently alleged concessions to the more "aggressive" Chinese viewpoint so widely publicized in 1960. Only the new concept of "national democracy" as a path to socialism for countries which permit Communist participation in government (Cuba and Indonesia, for example) may be considered a relatively original note in the dreary jargon of the text. Finally, in its denunciation of all forms of non-Soviet socialism, from the reformist Scandinavian, British, German and Austrian models to the "revisionist" Yugoslav variety, the program paraphrases—almost literally—the classic arguments of the Comintern and Cominform in relatively restrained language.

Productivity Promised

As an economic document the program presents only the barest outline of a 20-year project for economic, social, and educational progress. On the basis of past performance there is every reason to take this projection into the future seriously, however, in the heavy industrial sectors at least, and to resist the temptation to consider the whole a mirage because of the impracticality of some of its parts.

Meeting the targets of a 150 per cent increase over current (1960) gross industrial output by 1970 and a 500 per cent increase by 1980 will require the continued maintenance of an average rate of growth of nearly 10 per cent for the next two decades. For the planned increase in steel production to 250 million tons by 1980 * (from 65.3 million in 1960) the growth rate of the last two years must be held for the entire period; to expand electric power output from the 1960 level of 290 billion KWH to from 900 to 1,000 billion KWH in 1970, and 2,700 to 3,000 billion KWH in 1980, a slight acceleration to an annual increment of 12 per cent must be achieved. In 1946, when making a 15-year prediction for the production of steel (50 million tons), oil (50 million tons), and coal (500 million tons), on the basis of a war-ravaged economy, Stalin erred on the conservative side; in 1961 Khrushchev, making his prognostications on a much more solid foundation, shares little of his predecessor's conservatism, and his estimates—in heavy industry—will be certainly closer to the mark than Stalin's.

In a carefully qualified evaluation of the 20-year goals as defined in the program, The London *Economist* (August 15, 1961) has concluded that "there is no reason why Soviet industrial output should not forge ahead to its planned targets." But there are, naturally, some dissenting opinions. To Naum Jasny, a leading specialist on the Soviet economy, for example, the 20-year plan "marks a return to the unrealities in planning . . . the only industrial target which may be reached under favorable conditions is electric power" (*Christian Science Monitor,* August 16, 1961).

Regarding the agricultural targets there is almost total unanimity of skepticism—only the degree of doubt varies. From the same perspective of the past, there is little reason to believe that the abysmal record of Soviet farm output in the last 30 years can be suddenly improved to the extent the goals require. Despite a lack of progress in the first two years (1959-1960) of the seven-year plan after considerable advance between 1953-1958, grain production is expected to more than double by 1980, meat output is to increase "threefold in the first decade and fourfold in 20 years," and milk production is to "double by 1970 and rise threefold in 20 years." In the last decade, however, only a 5 per cent average annual gain was obtained in over-all agricultural output.

The goal of an annual rate of growth of 10 per cent in the sector for the 1960-1970 period—equal to that planned for industry—seems even more remote when it is recalled that almost the entire gain of the post-Stalin period derived from the tremendous extension (40 million hectares) of sown areas—a most effective input factor that is not likely to recur in the next decade. To double yields per hectare, which is the essence of the program's target for grain, is a near impossibility in an economy on the Soviet scale. Yet the grain target is still of an order of magnitude which in 20 years might be approached with 75 per cent fulfillment. The meat and milk goals, requiring multiplication of output by factors of two to four in the forthcoming decades, can only be considered fantastic.

The Farm Labor Problem

Even more unlikely of attainment are the planned increases of 150 per cent (by 1970) and "five to six times" (by 1980) in the productivity of agricultural labor—expectations which Jasny deems "stupendous" and "completely unfounded." These exceed the gains in productivity and wages expected for the industrial labor force. The investments to improve productivity will have to be enormous, but there is no indication of the allocation of resources through which this transformation is to be achieved.

The program contains little more than the usual platitudes concerning "elimination of socio-economic and cultural differences between town and country." Noteworthy, also, is the lack of comment with respect to the controversial process of changing the collectives into state farms. Nor is there any enlightenment as to how the eventual disappearance of the private plots and individual livestock holdings, which still account for nearly 50 per cent of the meat and milk and most of the vegetables reaching the consumer, is to be brought about.

At best, in the event that the 1980 targets are reached, Soviet agriculture will only have reached current U.S. levels with at least a threefold labor force. Success would signify, however, that the major weakness in the Soviet economy and the greatest obstacle to improved urban living standards—the stubborn, passive resistance and low productivity of the peasantry—had

* This is actually somewhat lower than the 1960 goal of 265 million tons given by Khrushchev in an interview with J. Curran (Pres., National Maritime Union) in July, 1960 (N.Y. *Times,* Aug. 16, 1960).

been broken. Agriculture, if the program's objectives are approached could be fully incorporated at long last into the Soviet planning processes. In 1961, even with the prospects of a record grain harvest of perhaps 150 to 155 million tons, the fulfillment of the agricultural targets has little more prospect of realization than the unkept pledges of the past.

More Things for Nothing

It does not require an overly close scrutiny of the program to realize that the abundance of goods and services which a communist society must provide is not promised for 1980. The fulfillment of the slogan of satisfaction "according to need" is, moreover, not to be a matter of individually determined personal requirements. Instead, the emergence of a kind of collective egalitarianism, based on carefully calculated "rational" consumption norms for food, clothing, consumer goods and services, will mark the next phase of communist development.

Primarily in those sectors where controls can be readily applied there will be a gradual transition to free distribution of either goods or services; but these highly propagandized free items currently involve a relatively small percentage—approximately 15 to 20 per cent—of total consumer expenditures. Rental charges, now less than 5 per cent of average incomes, are to be eliminated, but new housing in large apartment blocks still will be centrally allocated; by 1980, the present nine square meters per person in shared quarters (in the U.S. the comparable figure now is 27 square meters) should have grown to a little more than an average of 10.5 square meters per person in individual apartments for every family, including newlyweds.

In addition to free housing, and by 1980 such utilities as heat, light, gas, and public transportation, the advance of communism is to bring a vastly expanded network of communal feeding facilities, continued reduction of the working time to a six-hour day in a 30 to 36-hour week, free education from the boarding school through the university for some, and through 11 grades for all, and free medical care from the cradle to the grave. In one form or another, all of these have been promised before.

Yet, despite all reservations, there will be a meaningful, if not precipitous, advance towards a communist welfare state under Khrushchev in the coming decades. To a certain extent it will be possible to measure statistically the progress in this direction by the increase in the social consumption funds, which are to account for 50 per cent of average real wages in 1980, compared to from 30 to 40 per cent at present. The savings of the 15 to 20 per cent of wages now being spent on what will be free services and goods in the future will represent a change of only 1 per cent a year, which is certainly the minimum for any program presenting a design for a communist society. To finance these benefits, despite the abolition of personal income taxes, does not pose any problems; the increased revenues from the turnover taxes on the planned expanded consumer goods sales, and taxes on the growing profits of industrial enterprises, will provide more than sufficient funds during the first phase of communism. Money, prices, and profits are to remain, not as despised vestiges of a gloomy past, but as respected symbols of a glowing future. For most material personal needs, Soviet workers still will have to depend primarily on the earnings from their labor, and this will be true to an even greater extent for the peasantry, who still make up nearly one half of the population and only now—after four decades—are to become eligible for the social security benefits listed in the program for 1970 and after.

The Party Will Not Wither

Consistent with classical theory, the coming era of economic abundance is to have as its political corollary "the withering away of the state." But just as the full material benefits of communism must await a still indeterminate date beyond 1980, the Soviet state has been granted another reprieve from its doctrinal death until communism has won its "contest with capitalism in the international arena." In achieving this victory, a greatly improved system of economic co-operation with the other members of the Sino-Soviet bloc is to move these countries, with economies as different as those of N. Viet Nam and the DDR, and problems as varied as those of China and Czechoslovakia, "more or less

A cartoon from "Pravda."

simultaneously towards communism." But since socialism has been "fully and irrevocably" established in the Soviet Union, the Soviet state, according to Khrushchev's major theoretical innovation in the program, is no longer a "dictatorship of the proletariat"; it is now, we are told, the state of an entirely classless society and the dictatorship and its "coercive organs" can be gradually dismantled by a transition to "communist self-government which will embrace the Soviet trade unions, co-operatives, and other mass organization of the people."

No clue is given to the stage at which such nascent forms of socialist administration will be sufficiently developed to permit the Party to dispense with the instruments of coercion which have always been considered essential to Marxist-Leninists.

The monopoly of power of the Communist Party is neither challenged nor diminished. On the contrary, as Khrushchev has stated on numerous occasions, there will be "a further enhancement of the role and importance of the Party as the leading and guiding force of Soviet society." Although the proposals to limit the period of office for all indi-

(Concluded on page 56)

Institute Yesteryears

25 Years Ago . . .

PRELIMINARY 1936-1937 registration figures showed a total enrollment of 2,781 (up 237 from the previous year), including 602 (up 85) in the Graduate School and 636 (up 68) entering freshmen of the Class of 1940.

Equally encouraging news was to be found in the third Annual Report of Treasurer Horace S. Ford covering fiscal 1935-1936, during which, for the third year in succession, the Institute had lived within its budgeted income.

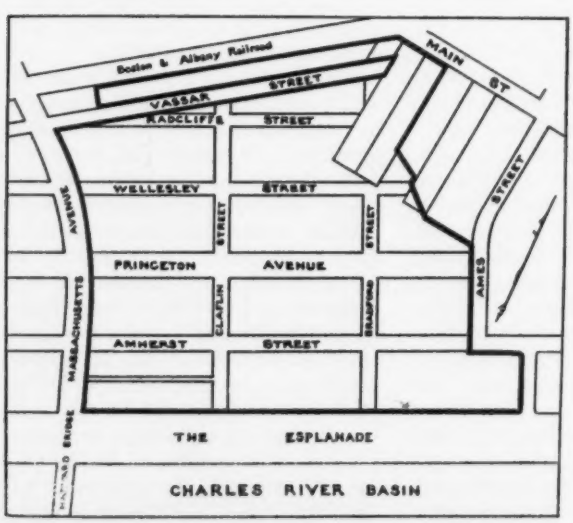
As The Review editors noted, "There was a balance resulting from operations of $4,614.69. There were also credits from the results of previous years' operations amounting to $4,021.67. These items, applied to the Institute's all-time cumulative operating deficit since 1865, reduced the latter to $16,314.86. . . .

"The balance sheet shows endowment funds totaling $32,327,617. . . . The market value of all securities held June 30, 1936, was 113% of their book value, the figures for the previous years being: 66% in 1932; 82% in 1933; 93% in 1934; and 102% in 1935."

¶ Professor B. Alden Thresher, '20, became Director of Admissions; and among the new Faculty members welcomed at the opening of 1936-1937 was Arthur von Hippel, as Assistant Professor in the Department of Electrical Engineering.

50 Years Ago . . .

"ATTENDANCE AT the Institute continues to increase slowly as it has for several years past," observed The Review. "The present enrollment of 1,567 [for 1911-1912] is within 41 of the high-water mark record of 1902-1903, the last year of the $200 tuition fee. . . ."



A Cambridge site as shown in the November 1911 Review.

¶ The Annual Report of William B. Thurber, '89, Treasurer of the Institute, covered the nine-month period from September 30, 1910, to June 30, 1911, since the Executive Committee of the Corporation had voted to change the Institute's fiscal year from October-September to July-June.

Mr. Thurber reported that during the nine-month period current income had been $484,199, which was $9,264 more than the expenditures. The invested assets had declined by $30,156 to a total of $2,184,561, but the book value of the educational plant was unchanged, at $1,703,036.

¶ In The Review for November, 1911, it was announced "that a site for the New Technology had been chosen on the Cambridge side of the Charles River Basin opposite the Back Bay section of Boston, between Harvard and West Boston bridges; the purchase of this land being contingent upon the closing of certain streets on the property by the city of Cambridge and the delivery of a good title by the owners.

"The tract in question comprises nearly 50 acres of land with a frontage of nearly one-third of a mile on the Charles River Basin esplanade and about a quarter of a mile on Massachusetts Avenue. It extends back from the river to the tracks of the Grand Junction Railroad operated by the Boston & Albany. The property is crossed by several proposed and accepted streets, although these streets have not been actually constructed. The Corporation proposes as a condition of purchase, that the city of Cambridge close all these streets with the exception of Vassar Street which runs near the railroad tracks and parallel with them, and which will be extended to Main Street as a teaming thoroughfare.

"The announcement of the selection of this site was received with profound satisfaction by the Faculty and the Alumni as well as by the people of Boston. Although there has been much diversity of opinion as to which one of the contemplated sites should be selected, the strategic character of the land chosen, its wonderful possibilities of development, its generous area and its accessibility, appeal strongly to every interested person.

"The chief act now remaining to complete the transaction is an enactment by the city of Cambridge closing certain streets on the property, and in view of the numerous and cordial invitations which the Institute has received from representative bodies in Cambridge, to locate there, it seems likely that the conditions of acceptance demanded by the Institute will be complied with."

By the end of June, 1911, a decision had been reached favoring removal to Cambridge, providing the price for the land could be made right. But the eager expectations of the owners, of whom there were 35, brought matters temporarily to a halt over the summer. Negotiations were reopened in October, and on the 11th of that month, the Corporation voted to purchase the land at a price of $775,000—some $225,000 less than originally had been asked.

75 Years Ago . . .

REGISTRATION FOR 1886-1887 totaled 637, an increase of 28, or 4.5 per cent, over 1885-1886. There were 198 freshmen of the Class of 1890, or 11 more

(Concluded on page 70)

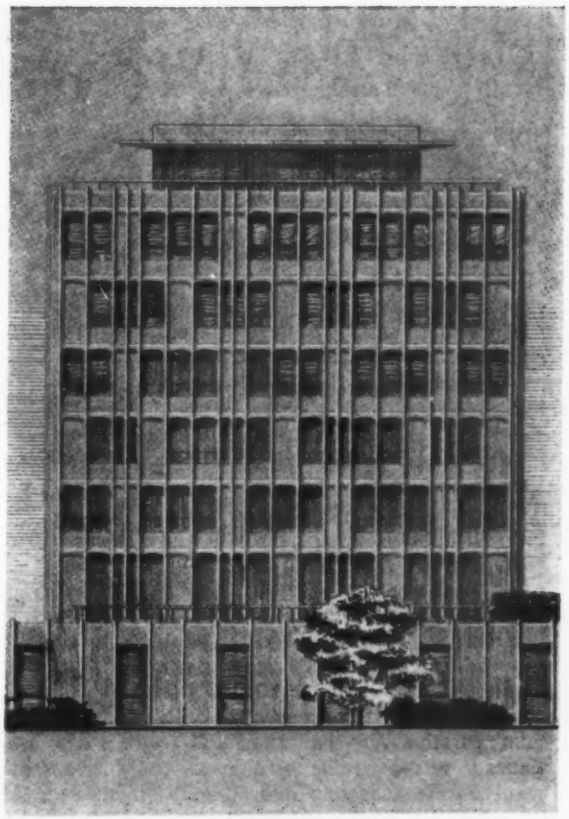
New Buildings to Rise at the Institute Soon

THE MOST BUILDING that M.I.T. has undertaken in many years will get under way next year. In addition to the Green building for the earth sciences, new housing for married students and a new women's dormitory are scheduled to go up in the near future.

A sketch of the proposed facade for the women's dormitory is at the right. This structure will be at the corner of Memorial Drive and Danforth Street, where many visitors to Kresge Auditorium have parked heretofore. It will accommodate 125 women students (new parking places are to be provided elsewhere). Anderson, Beckwith and Haible are the architects.

Below is a study model for the married students' apartments to which five acres have been allocated on West Campus. The high building will have 90 efficiency apartments and 60 one-bedroom apartments; the low ones nearby will have 60 two-bedroom apartments. This is a self-amortizing project financed with the help of the Housing and Home Finance Agency. Hugh Stubbins and Associates are the architects.

Emeriti professors were among the first to hear about M.I.T.'s building plans. Twenty-eight emeriti, including Professor Charles E. Fuller, '92, who is now 90 years old, heard Ovadia R. Simha, '57, Planning Officer, describe the plans for the future at their meeting last spring.



Staff News

Two New Vice-presidents Are Appointed

M.I.T. BEGAN the current academic year with two new Vice-presidents, *Philip A. Stoddard, '40,* and *Malcolm G. Kispert, '44.* Mr. Stoddard is concerned with Operations and Personnel, and Mr. Kispert with Academic Administration.

Mr. Stoddard, who was formerly Vice-treasurer, now has executive responsibility for all of the Institute's physical facilities, the planning and execution of construction work, and the management of housing and dining facilities. He also has broad responsibilities for personnel policies, procedures, and management.

Mr. Kispert, who formerly was administrative vice-chancellor, continues to be responsible for management of the academic budget and allocation of space for academic purposes. He also represents the President on administrative matters affecting the offices of Student Affairs, Admissions, Student Aid, the Registrar, the Medical Department, Placement, and Public Relations.

Mr. Stoddard has been associated with M.I.T. since becoming an assistant to the executive officer of the Instrumentation Laboratory in 1947. Mr. Kispert became assistant to President Karl T. Compton in 1946, and has filled key posts at the Institute ever since.

Philip A. Stoddard, '40

Drawings by Henry B. Kane, '24

Malcolm G. Kispert, '44

Joseph J. Snyder, '44, Carl F. Floe '35, and James McCormack, '37, also serve M.I.T. as vice-presidents.

Professor Overhage

THE DIRECTOR of Lincoln Laboratory, *Carl F. J. Overhage,* has been appointed professor of engineering at M.I.T., and is now assisting the Dean of Engineering and the Engineering Council in an advisory capacity on matters relating to the organization of new educational activities and the Research Centers in the School of Engineering.

Dr. Overhage has long sought to bring many of the basic research and engineering activities of Lincoln Laboratory into closer relationship with the educational objectives of the Institute, and his new appointment will facilitate this work.

(*Concluded on page 42*)

Joseph J. Snyder, '44

James McCormack, '37

Carl F. Floe, '35

BUSINESS IN MOTION

To our Colleagues in American Business . . .

How would you like to save $100,000 this year? One of our customers learned how. This leading manufacturer—you'd recognize the name immediately—is a heavy user of copper and its alloys. It buys sheet, strip, tube and rod, by the hundreds of tons annually.

Recently this company invited the Revere Technical Advisory Service to inspect its operations, study its metals needs, analyze its buying practices and look into specifications — all with an eye toward accomplishing possible savings. The Revere people were actually treated as members of the crew at the company's plants; nothing pertinent was kept secret, no knowledge hidden.

The result was recommendations all down the line on every phase of copper alloy procurement and use. Here a new alloy was recommended, there a new way of handling the metal. In one instance individual shipment sizes were trimmed down, in another the change of gauge eliminated scrap entirely and provided more pieces per coil. We cite only a few examples. There were many more. And when the Revere Technical Advisory Service had completed its study, specific and concrete recommendations were made to the metals user. These actually showed the way to make an astonishing saving . . . well over $100,000 annually!

Naturally, not every company can expect to realize such vast savings as these. Too many variables enter into any such study. But if detailed knowledge of metals, their manufacture and their uses be applicable to *your* product and *your* production, why not — without obligation — call in a Revere Technical Advisor and bring his experience to bear on your problem?

You can discuss your metals problems and production procedures with him in the utmost confidence. He may be reached simply by calling or writing the Revere Office nearest you. No obligation, of course.

In fact, it will generally pay you to take every one of your suppliers into your confidence; discuss your problems in detail. Thus you will add their abilities and experience to your own, to the eventual advantage of both your company and your suppliers.

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Staff News

(Concluded from page 40)

Heads Two Departments

BOTH the Department of Mechanical Engineering and the Department of Naval Architecture and Marine Engineering are now headed by *Professor H. Guyford Stever,* a member of the Faculty since 1946.

"The appointment of one man to head two departments is not without precedent at M.I.T., and it in no way means that we are combining the Department of Mechanical Engineering with that of Naval Architecture and Marine Engineering," President Julius A. Stratton, '23, said in announcing Professor Stever's appointment.

"Under Dr. Stever, each department will retain its professional identity and will award degrees in its own fields of specialization. At the same time, both departments have common interests in a number of areas, and the new administrative structure should strengthen these collaborative efforts to the mutual advantage of each department."

In the Department of Mechanical Engineering, Professor Stever succeeds Professor Joseph H. Keenan, '22, who has resumed full-time teaching and research; and in the Department of Naval Architecture and Marine Engineering he succeeds Professor Laurens Troost, who retired in 1960 to return to Holland.

Professor Stever received his doctorate in 1941 at the California Institute of Technology and first came to M.I.T. as a member of the Radiation Laboratory's staff. He was formerly chief scientist of the U.S. Air Force, was associate dean of the School of Engineering from 1956 to 1959, and is currently president of the Institute of the Aerospace Sciences, Inc.

Ross H. Smith

Director of Athletics

ROSS H. SMITH, director of physical education and assistant athletic director at Cornell University since 1952, replaced Richard L. Balch as M.I.T.'s Director of Athletics in August. Mr. Balch resigned to accept a position at Stanford University.

Mr. Smith has been a coach and athletic administrator since he was graduated from Springfield (Mass.) College in 1936. After coaching at Brighton High School in Rochester, N. Y., he received a master's degree in education at the University of Rochester in 1947 and went to Cornell as a soccer and basketball coach.

At Springfield he was outstanding in lacrosse, soccer, and basketball, and was named to the All-New England lacrosse team and the All-American soccer team. His lacrosse teams at Cornell have made remarkable records.

Mr. Smith has been one of the East's leading basketball officials for several years and was president of the U.S. Intercollegiate Lacrosse Association in 1957. He was in charge of the successful tour of the combined Cornell-Dartmouth-Yale soccer team in Bermuda in 1952, and conducted soccer clinics for service coaches in 1955 and 1956 at the invitation of the Commanding General of the U.S. Army in Europe.

At M.I.T. he will supervise the coaching staff and physical education instructors and direct the large and varied athletic plant that now includes the Du Pont Athletic Center, Briggs Field House, Rockwell Cage, the Armory, the Alumni Pool, and more than 20 acres of tennis courts and outdoor playing fields.

Henry J. Zimmermann, '42

RLE's New Director

TO SUCCEED Professor Jerome B. Wiesner, who is on leave of absence in Washington, as director of the Research Laboratory of Electronics, President Stratton has appointed *Professor Henry J. Zimmermann, '42.* His previous responsibilities as associate director have been assumed by *Professor Wilbur B. Davenport, Jr., '43.*

Professor Zimmermann has been a member of the Faculty since 1946 and is co-author with Professor Samuel J. Mason, '47, of two recent books, *Electronic Circuit Theory* and *Electronic Circuits, Signals, and Systems.*

Professor Davenport returned to the Department of Electrical Engineering last year after nine years at Lincoln Laboratory. He is co-author with William L. Root, '43, of *An Introduction to the Theory of Random Signals and Noise.*

Professor Walter A. Rosenblith is serving as acting chairman of the Steering Committee of the Center for Communication Sciences during Professor Wiesner's absence.

OEG Appointments

THE DIRECTOR of the Operations Evaluation Group (OEG) of M.I.T., Jacinto Steinhardt, has announced the appointment of Sidney K. Shear as Director of Research of the Naval Warfare Analysis Group, and the addition of Robert L. Hubbard and Edgar R. Terry to the OEG's staff in Washington, D.C.

Dr. Shear succeeds Douglas L. Brooks, '43, who joins M.I.T.'s Center for Earth Sciences.

The Investor is "in Politics"

Thousands of government rulings, directives, regulations, contracts, contract cancellations, appropriations, and of course, *laws*, all have an impact on corporate earnings—and, naturally, on investment values.

How can the *individual* investor keep alert to such events, as they affect him? We doubt that he can—yet we find that these are factors we must use in shaping *our* investment decisions.

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Individuals Noteworthy

(*Continued from page 10*)

B. E. Hutchinson: 1888-1961

A LIFE MEMBER of the M.I.T. Corporation and a former president of the Alumni Association, B. Edwin Hutchinson, '09, died of a heart attack on September 27 at his home in Grosse Point, Mich.

Mr. Hutchinson helped organize the Chrysler Corporation in 1924, and served it as vice-president, treasurer, and a director until his retirement in 1954. From 1935 to 1954 he was also chairman of the Chrysler Finance Committee. He was a director of the National Bank of Detroit. Earlier in his career he had been in the steel industry and had been vice-president and treasurer of the Maxwell Motor Co.

He served on M.I.T. Visiting Committees concerned with Aeronautics and Astronautics, Sponsored Research, Modern Languages, Economics, and Humanities, and headed the Alumni Association in 1941-42. He became an alumni term member of the Corporation in 1936, and was elected a life member in 1951.

E. R. Schwarz: 1899-1961

THE HEAD of the M.I.T. Division of Textile Technology, Professor Edward R. Schwarz, '21, died on July 27 after a heart attack at his summer home in Ocean Park, Maine. Professor Schwarz became an instructor in 1925, assistant professor in 1929, associate professor in 1934, professor in 1937, and was given charge of the Samuel Slater Memorial Research Laboratory when it was founded in 1945. He was one of the world's leading textile engineers.

Professor Schwarz was a founding fellow of the Textile Research Institute and had served as its vice-president and chairman of the Board of Editors of *Textile Research Journal*. He was also a fellow of the British Textile Institute and the American Association for the Advancement of Science, an honorary life member of the American Association of Textile Technology and the American Society of Quality Control, and a member of the American Institute of Physics, the Fiber Society, and the National Fire Protection Association. He received both the Olney Medal of the American Association of Textile Chemists and Colorists and the Harold DeWitt Smith Memorial Medal of the American Society for Testing Materials.

His home was in Melrose and he is survived by a son, Edward H. Schwarz, '53, and two daughters, Mrs. Robert W. Perkins, Sr., of Ypsilanti, Mich., and Mrs. Kenneth E. Cox of Ocean Park.

Faculty Notes

THE George Westinghouse Award for outstanding contributions to teaching was awarded to Professor *David C. White* at the annual meeting of the American Society for Engineering Education. . . . Professor *Arthur R. von Hippel*, a frequent contributor to The Review, has been elected vice-president in charge of Fundamental Materials Research of the U.S. Sonics Corporation . . . Guatemala has awarded the Order of Rodolfo Robles to Professor *Nevin S. Scrimshaw*, Head of the Department of Nutrition, Food Science and Technology.

(*Continued on page 46*)

TYCO OPPORTUNITIES

the MATERIALS RESEARCH LABORATORY

Materials Research Laboratory provides the basic research capability for TYCO development and manufacturing companies, and for sponsored research programs. The laboratory, occupying new facilities on Route 128 in suburban Boston, is engaged in research and development of novel device materials, with emphasis on their fundamental properties. Present research efforts are in the field of new electronic, magnetic and high temperature materials for application in energy conversion devices: thermoelectrics, solar and fuel cells.

Positions exist for scientists with advanced degrees and a record of creative accomplishment in the following fields:

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CERAMICS

The laboratory encourages the publication of significant achievements and participation in the scientific community. In addition to excellent fringe benefits and salary, senior personnel are eligible to participate in a stock option program.

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Dr. Arthur J. Rosenberg, Director
Materials Research Laboratory
Hickory Drive, Bear Hill
Waltham, Mass.

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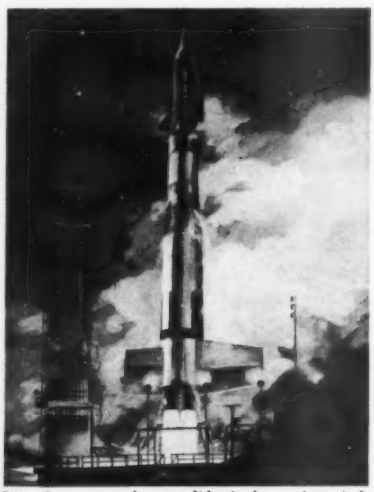
Drawing of newly announced short-to-medium range Boeing 727 jetliner. First 727 sale was largest in transportation history. More airlines have ordered—and *re*-ordered—more jetliners from Boeing than from any other manufacturer.

Boeing KC-135 jet tanker-transport is U. S. Air Force's principal aerial refueler. Thirty C-135 cargo-jet models of KC-135 have been ordered for Military Air Transport Service.



Dyna-Soar manned space glider is shown, in artist's concept, atop Titan ICBM for launching. Design will permit return for conventional landing. Boeing is prime contractor for glider and system.

Boeing gas turbine engine powers this pleasure boat demonstrator. In other applications, Boeing engines power U. S. Navy boats and generators.

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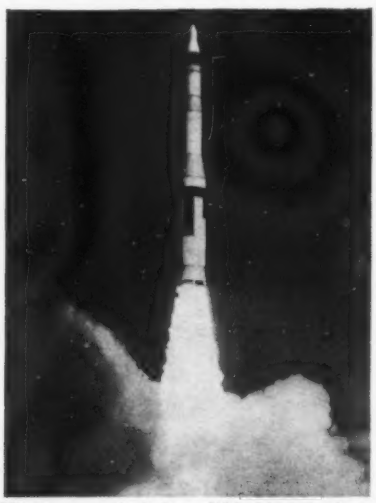
For further information, write today to Mr. Conrad E. Brodie, The Boeing Company, P.O. Box 3822 - UMT, Seattle 24, Washington. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.



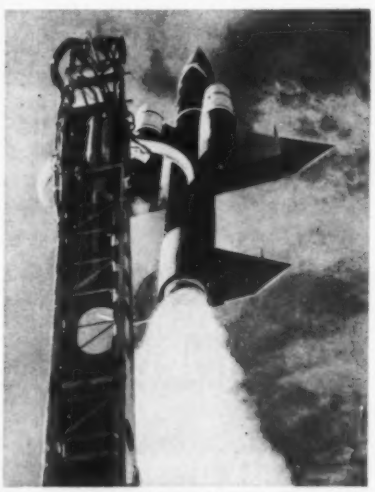
Minuteman, nation's first solid-fuel intercontinental ballistic missile, shown on initial flight—most successful first flight in missile history. Boeing holds major Minuteman contract responsibility.

Boeing Scientific Research Laboratories where scientists expand the frontiers of knowledge in research in solid state physics, flight sciences, mathematics, plasma physics and geo-astrophysics.

BOEING

Boeing-Vertol 107 helicopter shown with famous Boeing 707 jetliner, world's most popular airliner. Boeing is world leader in jet transportation.

Boeing B-52H shown carrying mockups of Skybolt air-launch ballistic missiles. B-52s are also jet-fast platforms for Hound Dog guided missiles, and in addition carry regular load of gravity bombs.



Supersonic Boeing BOMARC, longest-range air defense missile in U. S. Air Force arsenal, is now operational at Air Defense Command bases. New "B" model has range of more than 400 miles.

Drawing of 115-foot hydrofoil craft Boeing is building for U. S. Navy. Riding out of water, craft will "fly" at speeds up to 45 knots on underwater wings.

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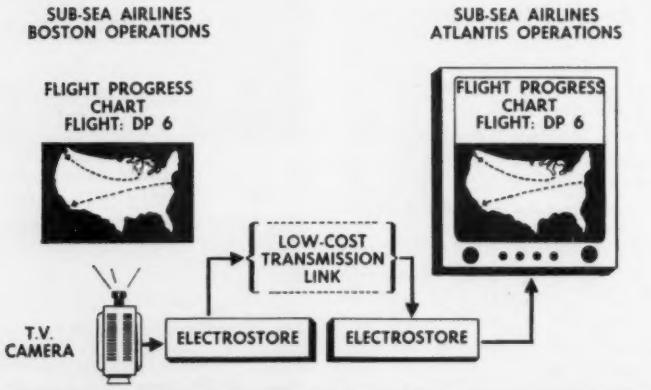

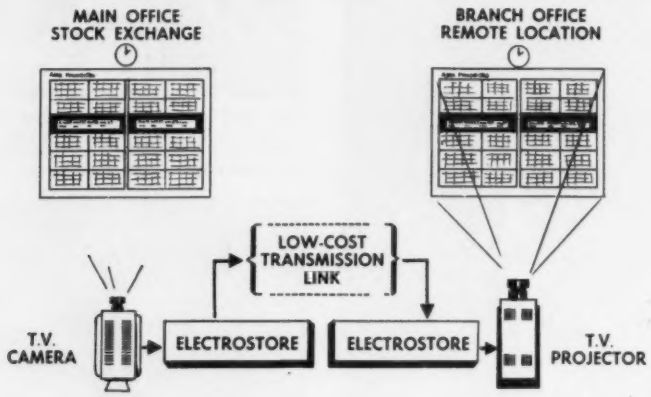

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Individuals Noteworthy

(Continued from page 44)

The New Provost

CHARLES H. TOWNES, one of the nation's most distinguished physicists, came to M.I.T. this fall as Provost. In this post he will share with the President the responsibility for general supervision of the Institute's educational and research programs.

"The office of Provost," President Julius A. Stratton, '23, said in announcing the appointment, "is being re-established at M.I.T. in recognition of the continuing growth and development of the Institute and of the tremendous range and variety of our interests. We are fortunate to secure a man of such exceptional scientific and administrative competence as Dr. Townes to fill this important position."

Dr. Townes has been on leave from Columbia University for the last year to serve as vice-president and director of research for the Institute for Defense Analyses, a non-profit organization operated by M.I.T. and eight other universities. He is best known for his work on the theory and application of masers.

"Maser" is an acronym for "microwave amplification by stimulated emission of radiation."

As a member of the Bell Telephone Laboratories staff from 1939 to 1947, he did extensive work on radar bombing systems and in the then emerging field of microwave spectroscopy. He became associate professor of physics at Columbia in 1948, professor in 1950, and after serving two years as executive director of the Columbia Radiation Laboratory he became chairman of the physics department there.

Sloan Teaching Interns

SEVEN men from six schools are now Sloan teaching interns in the M.I.T. School of Industrial Management. They are *Curtis H. Jones* and *Bernt P. Stigum,* from Harvard; *Arthur J. Boness, Jr.,* University of Chicago; *Ernest A. Lowe,* University of Leeds; *James B. Ludke,* University of Massachusetts; *Donald E. Porter,* San Francisco State College; and *Richard D. Terrell,* Oxford University.

(Concluded on page 48)

FLETCHER CHAMBERLIN AND OLNEY MORRILL TALK ABOUT PERSON-TO-PERSON SERVICE AND WHAT IT MEANS FOR THE CUSTOMERS OF THE NEW ENGLAND MERCHANTS NATIONAL BANK

(Mr. Morrill is a Senior Vice President and Mr. Chamberlin is a Vice President of the newly formed New England Merchants.)

MORRILL: You know, I've been in banking a long time, but I'll never lose the satisfaction I get when someone says: "Will you help me with my banking problems?"

CHAMBERLIN: Well, that's the kind of question that leads to the person-to-person service we emphasize.

MORRILL: Right. And we welcome the responsibility which goes along with it.

CHAMBERLIN: That's exactly the way I think of it, because we always took this responsibility very seriously at The New England Trust before our consolidation, the same way you did.

MORRILL: One thing: it isn't a general or group responsibility either—but a *personal* responsibility for each customer and his needs. Not always an easy job, but it is a vital one.

CHAMBERLIN: And a sense of responsibility like this seems to translate itself naturally into the person-to-person service the new New England Merchants offers every customer . . .

MORRILL: Whether his business is in our commercial or trust department or anywhere else in our Bank.

CHAMBERLIN: When you come right down to it, the basis for our personal service is really very simple. We try to put ourselves in our customers' shoes—that way, we gain a better insight into their needs.

MORRILL: And that's how we arrived at many of our services: having banking windows open ten hours a day, a new motor bank, an investment plan for those with $5,000 or more to invest—just to name a few.

CHAMBERLIN: Sounds like a pretty good bank to do business with, doesn't it?

NEW ENGLAND MERCHANTS NATIONAL BANK
28 State Street, Boston MEMBER F.D.I.C.

Individuals Noteworthy

(Concluded from page 46)

New Posts

NAMED in the news recently were the Alumni whose elections, promotions, and appointments follow:

William C. Foster, '18, as first Director, U.S. Arms Control and Disarmament Agency;

Joel Y. Lund, '23, as President for another term, Proprietary Association, Washington, D.C. . . . *John F. Hennessey, '24,* as a member, Board of Education, New York City . . . *Edward R. Huckman, '26,* as General Sales Manager, The Foxboro Company, Ltd.;

John R. Kimberley, '26, as a Director, Corning Glass Works . . . *Nathan Cohn, '27,* as President-elect-Secretary, Instrument Society of America . . . *William J. Kirk, '28,* as a Trustee of the New York, New Haven & Hartford Railroad;

Sears L. Hallett, '29, as publisher, *Practical Builder* magazine . . . *Gordon S. Brown, '31,* as a Director, United-Carr Fastener Corporation . . . *Charles B. McCoy, '32,* as a Vice-president, Director, and member of the Executive Committee, E. I. du Pont de Nemours and company;

Cole A. Allen, '33, as Vice-president, American Mutual Liability Insurance Company . . . *H. Gordon Scowcroft, '35,* as Marketing Vice-president, Special Products Division, Lever Brothers Company . . . *Norman A. Matthews, '37,* as Group Leader, Ferrous Metallurgy, Research Laboratory, International Nickel Company, Inc.;

Dale F. Morgan, '38, as Manager-Sales Administration, Union Carbide Olefins Company . . . *Charles V. F. DeMailly, '40,* as Vice-president, Plymouth Cordage Company . . . *Richard O. Spalding, '40,* as Manager, General Service and Transportation, Glass Container Division, Owens-Illinois;

Herman A. Affel, Jr., '41, as Vice-president, Auerbach Electronics Corporation, Philadelphia, Pa. . . . *Rogers B. Finch, '41,* as Director, University Relations, U. S. Peace Corps . . . *Raymond F. Koch, '41,* as Vice-president-Secretary, Comptometer Corporation;

Stanley M. Smolensky, '41, as General Manager, National Electronics Division, Thiokol Chemical Corporation . . . *Jack R. Williams, '42,* as Vice-president—European Operations, Worthington Corporation . . . *Thomas M. Bennett, '43,* as Administrative Manager, Engineering Development Center, The Lummus Company;

Robert J. Reilly, '44, as Vice-president, Atlas Chemical Industries, Inc. . . . *David R. Clare, '45,* as Vice-president, Manufacturing, Johnson & Johnson . . . *Arthur Y. Taylor, '46,* as Executive Vice-president, Jackson & Moreland, Inc.;

Stephen W. Moulton, '47, as Associate Director of Research, Philco Corporation . . . *Robert L. Deming, '48,* as Manager, Engineering and Development, Tracerlab Reactor Monitoring Center, Richmond, Calif. . . . *William J. Weisz, '48,* as Vice-president, Communications Division, Motorola Inc.;

Charles W. Pike, '49, as Vice-president, Operations, Merck Sharp & Dohme . . . *Maurice L. Torti, Jr., '53,* as Director, Metallurgical Research, Metals Division, National Research Corporation . . . *Harrison T. Price, '55,* as Manager, Manual Transmission Plant, Chevrolet Motor Division, Saginaw, Mich.

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Trend of Affairs

(Continued from page 22)

Solar Heating Proves Costly

PROFESSOR ALBERT G. H. DIETZ, '32, reported conclusions reached in M.I.T.'s fourth solar house experiment at a recent United Nations Conference on New (nonnuclear) Energy Sources in Rome.

This was a three-bedroom home in Lexington, Mass., occupied for three years by Claremont D. Engebretson, a research associate in Mechanical Engineering, and his family. Solar energy was trapped in a 16-by-40-foot collector made of two layers of glass over an aluminum sheet painted black. Water pumped through copper tubes attached to this sheet was heated and stored.

Sunshine hitting this collector, it was found, could provide two-thirds of the energy required to heat the house and provide a hot water supply for the family. More storage space would have been required for total solar heating and at present, it was concluded, the cost of mechanical equipment would be higher than fuel savings would justify.

Professor Dietz said the engineering knowledge gained in constructing and operating a complex solar heating plant was the most valuable result of this experiment. "In countries where conventional fuels are abundant," he observed, "the use of solar energy for heating is economically attractive only where the climate permits an unusually high yield of sunshine per square foot."

Solar energy research at M.I.T. has been financed for several years by a grant from Godfrey L. Cabot, '81. The researchers planned to convert the Lexington house into a conventional home and sell it this fall, but to continue other projects.

The Titan's Guidance

LIKE the THOR and the POLARIS, the Air Force intercontinental ballistic missile, TITAN II, has an automatic guidance system from M.I.T. The Instrumentation Laboratory, headed by Professor Charles S. Draper, '26, designed and tested the stable inertial platform at the heart of its system, and many Alumni had a hand in the work.

Among them were Roger B. Woodbury, '48, Elmer J. Frey, '49, John E. Kirk, '49, William G. Denhard, '42, Michele S. Sapuppo, '52, Edward J. Hall, '57, Philip N. Bowditch, '46, Philip J. Gilinson, Jr., '36, Richard H. Frazier, '23, David C. Whipple, '48, George A. Oberbeck, '48, Richard E. Marshall, '51, Milton B. Trageser, '51, and Kenneth Fertig, '50.

The Loads on the Roads

THE National Bituminous Concrete Association has awarded a $4,500 fellowship to Edward M. Krokosky, '58, to study bituminous (or asphalt) concrete, the paving material used on black-top roads. He will seek to determine how the material recovers from deformations under different loading rates at different temperatures. Such work is expected to lead to new measurement techiques helpful to engineers called on for predictions as to how specific surfaces will stand up.

Egons Tons, '54, Assistant Professor of Transportation Engineering, and Rodney D. Andrews, Jr., Assistant Professor of Materials, will supervise Mr. Krokosky's research.

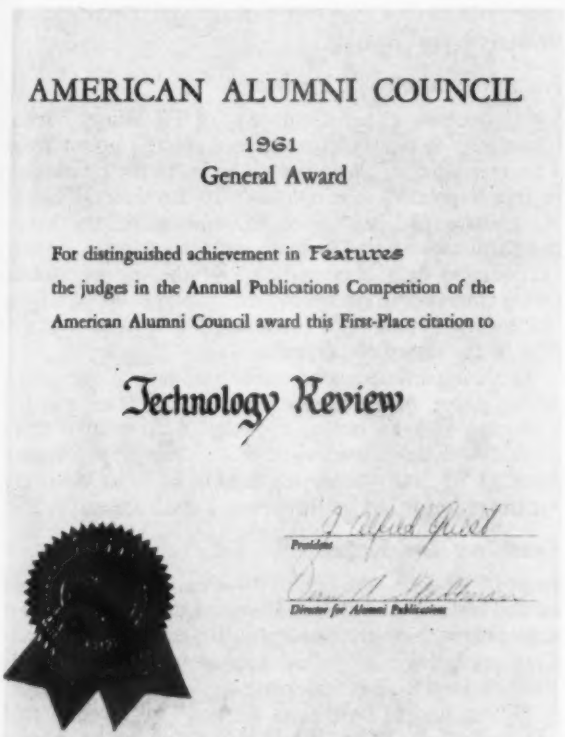
M.I.T. Publications Acclaimed

THE M.I.T. Offices of Public Relations and Publications were highly honored this year at the national meetings of both the American College Public Relations Association and the American Alumni Council.

In competition sponsored by the former, the Institute's general public relations and development projects for the Centennial year, its general catalogue, and 1960 annual report won top honors and its development brochures received additional recognition.

The American Alumni Council, after awarding prizes to M.I.T. for special events promotion, volunteer solicitors' materials, and capital campaign appeals, added a special award to the Institute "for the over-all visual impact and the unity and fine impression of its materials," and noted that "particularly outstanding were the capital campaign pieces, employing design excellence and visual design vitality."

The Technology Review was honored for being outstanding among alumni magazines in its category for the quality of its featured articles.



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Research at Round Hill

THE RESEARCH PROGRAMS of Lincoln Laboratory at the Round Hill Field Station in South Dartmouth, Mass., will be ended this year, but the M.I.T. Department of Meteorology will continue its work there. Most of the Lincoln personnel involved have been transferred to other programs in the main laboratory in Lexington, Mass., and at other field stations.

Much of the fundamental work in ionospheric and tropospheric scatter of radio communications during the last decade was done at Round Hill, and this work has figured in world-wide military communication systems.

(Concluded on page 52)

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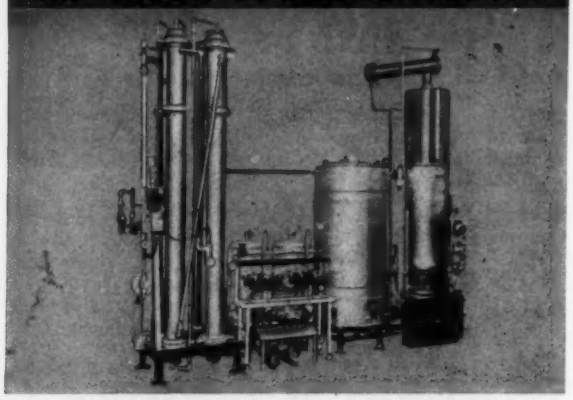

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Trend of Affairs

(Concluded from page 51)

Atomic Naval Power

THE NAVY'S first nuclear-powered surface ship, the *U.S.S. Long Beach* (CGN-9), was completed last summer at the Bethlehem Steel Shipbuilding Company's Fore River Yard in Quincy. Captain Edgar H. Batcheller, '39 (Rear Admiral Selectee, summer 1960), has been supervisor of shipbuilding there.

The *Long Beach* is the first U.S. cruiser designed and built from the keel up since World War II. Twin nuclear reactors driving twin screws constitute her power plant, and she is the first cruiser to rely solely on guided missiles for her major offensive and defensive power.

Captain George L. Street, 3d, Professor of Naval Science at M.I.T. and prospective Commander of Submarine Squadron Five in the Pacific fleet, escorted Dean Gordon S. Brown, '31, of the School of Engineering, on a one-day cruise on the *Long Beach* in July, during which her propulsion plant and electronic installations were tested.

Atomic Industrial Power

THE Fitchburg Paper Company, of Fitchburg, Mass., is planning to obtain its steam and electric power from a nuclear reactor. "We want to be in on the pioneering of this important development," its President, George R. Wallace, 3d, explained in announcing the company's proposal to participate with the Atomic Energy Commission in a demonstration of the use of atomic power for industrial operations. George R. Wallace, '13, former President of Fitchburg Paper, is now chairman of the Board of Directors.

The company uses enormous amounts of steam for drying paper during production, and the plans call for a reactor with an output capacity of from 30,000 to 40,000 thermal kilowatts at steam pressures ranging from 15 to 200 pounds per square inch, to be ready for operation in about three and a half years.

Fertilizer for Korea

HAROLD R. SEYKOTA, '39, saw Korean engineers whom he had trained take charge of one of the world's largest urea plants this year. Built by his company, Vulcan-Cincinnati, Inc., 85 miles southwest of Seoul, it is Korea's largest chemical plant.

"Korea had to have such a plant," he recently told an interviewer, "because there are too many people there for the land to support. The people we tried to benefit realize what we did and they are our friends. The whole project made a tremendous impression. It gave the United States a very lofty reputation and is one of the reasons we are welcome there now."

Humanities Concerts

THE Juilliard String Quartet will present the complete cycle of 16 Beethoven string quartets in the M.I.T. Humanities Series this academic year. The concerts are to be given at 3:00 P.M. Sunday afternoons, November 19, December 10, January 14, February 11, and March 18, in Kresge Auditorium. Series tickets are $8, and may be ordered by calling Ext. 2910 at M.I.T.

A little kid has lots of heroes. That mighty halfback. The cop at the corner. And the top hero of all — *Dad.*

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Missile Makers' Instrument

(*Concluded from page 29*)

red cells that carry oxygen to the body tissues and carry away carbon dioxide. The red cells are doughnut-shaped, and the exchange gases are concentrated in their circular outer rings. As these cells pass through capillaries, they line up like stacks of doughnuts. The gases are thus concentrated near the capillary wall through which they must pass to reach the tissues. But why this alignment occurs has not been clear.

The M.I.T. and Harvard investigators believe the non-Newtonian character of plasma may explain it. Plasma between the cell and the capillary wall, they think, may be subjected to a fast flow rate and its viscosity may be low. Hence, this thin plasma may serve as a lubricant to help stacks of cells move through the vessel smoothly and quickly.

Plasma trapped between the membranes that cover the centers of the doughnut-shaped cells, meanwhile, would be almost stationary, and its viscosity would be high. Studies with the Polaris-born instrument indicate, in fact, that it may be so high that the plasma almost becomes a gel and thus serves to cement the cells into their stacklike alignment for the trip through a capillary.

Drs. Merrill and Wells have found, too, that anticoagulant drugs tend to make plasma more nearly Newtonian, that is, to make its viscosity less dependent on flow rate.

M.I.T. MEN WON the national dinghy championship this year for the 11th time in 25 years. Here with the trophies are, left to right (in back), Robert M. Gray, '64, Meyer D. Lifschitz, '63, Kenneth A. Klare, '63, Warren H. McCandless, '62, (in front) Donald E. Nelsen, '61, and Peter R. Gray, '61.

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Watertight Coaxial Cables for Polaris

Now available! Coaxial cables which maintain hydrostatic integrity at pressures 500 and 1,000 PSI. Recent applications met the specialized demands of the Polaris missile firing submarines. The antenna mast system required coaxials* with the ability to withstand 500 PSI on the exposed end without leakage. In addition, they must remain watertight following subjection to an "S" bend at −54°C. BIW bonded polyethylene dielectric to the conductors and compound blocked the shielding braid. Care was taken to avoid altering the cable attenuation at prescribed frequencies. Rugged neoprene jackets were extruded by special techniques which controlled the O.D. and assured a tight fitting cable in the stuffing glands. Flexible armored versions are available.

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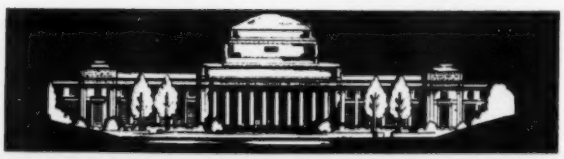

The Laboratory's staff of over 1000 under the direction of Dr. C. Stark Draper is engaged in the conception and perfection of completely automatic control systems for the flight and guidance of missiles and space vehicles. Its achievements include the Navy Mark 14 Gunsight, the Air Force A-1 Gunsight, Hermetic Integrating Gyros (HIG), and the Ship Inertial Navigation System (SINS). The Laboratory developed basic theory, components and systems for the Air Force THOR and, later, the TITAN missile. Other accomplishments include the Navy's POLARIS Guidance System.

Recently, the Instrumentation Laboratory was selected by NASA to develop the guidance navigation system for the moon space craft project, APOLLO.

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Khrushchev's Ticket

(*Concluded from page 37*)

viduals in elected offices may invigorate the Party leadership, and lessen the need to employ the violent techniques by which this was attained in the past, a significant exception adequately provides for the continuation of Khrushchev's own tenure—re-election by a three-fourths majority (of the Central Committee) in a secret ballot. In a system where many weeks of press discussion has not produced a single word of meaningful dissent to the draft program, the Party leader is obviously not yet prepared to redeem Lenin's 1919 pledge that the restrictions on political freedom would be lifted in a period of peace and plenty.

How Do Russians Feel?

It is, of course, impossible to measure the sincerity of the response of the Soviet people to the Party program as it is being presented in the rigidly controlled propaganda media. Certainly their feelings may be expected to run the gamut from apathy and cynicism among the older generation to ardor and zeal among the younger. In a recent Soviet novel, appropriately entitled *A Ticket to the Stars,* a young man speaks of the Party leaders and their promises in a manner which might well express the sentiments of the majority of those being led to collective happiness and plenty:

. . . I've had enough of those high flown phrases. They are used by many splendid idealists like you, but also by many villains. I am certain that Beria used them when he deceived the Party. Now we have learned better and they have become so much tinsel. Let's do without this hot air. I love my country, and our social order and will give my arm, my leg, or my life for them —but I am responsible only to my own conscience and not to some kind of verbal fetishes. They only stop you from seeing life realistically.

This young generation, the intended beneficiaries of Khrushchev's economic promises may, indeed, in a way still unforeseen, eventually complete the unwritten political section of his communist manifesto.

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"CHARGED PARTICLES"

Accelerators on the Research Frontier

We keep rewriting copy on this theme, and properly so. The needs of science for charged particles in nuclear structure research continue to create dynamic interest in Van de Graaff and microwave linear accelerators, and intensive development is leading to performance in energy and current that could not be considered even a short while ago. All the uses for higher energy, greater intensity, and more exacting specifications of stability and pulsing are not clearly known, but consideration of attainable accelerator performance may stimulate action on research programs lying dormant for lack of appropriate apparatus. The advanced characteristics here outlined can be contemplated now, due to recent technical advances in the design of accelerator components.

Energy

The capability of the Tandem Van de Graaff to reach into the range well above 20 Mev with precisely stabilized positive ions is a reality. Currents will be more than adequate for useful nuclear structure research.

New linacs of proven design extend high pulsed currents of electron beams to hundreds of Mev. They open up great areas of neutron physics and monoenergetic gamma work for physicists. The high power capabilities are now matched by sophisticated analyzing, deflecting and collimating systems which are as important to experimental work as the linacs themselves.

Intensity

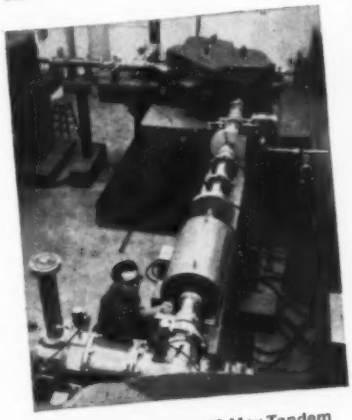
Electron or ion-beam currents in the one-ampere range at a few Mev can now be considered seriously. A specially-designed accelerator has shown excellent life performance at 1 Mev and 20 milliamperes of electrons as part of High Voltage Engineering's continuing test program to reduce the cost of ionizing radiation energy at high power levels.

The X-ray and neutron outputs from these beams are indeed heroic: X-rays — millions of rads per minute at a few centimeters distance. Neutrons — 10^{15} neutrons per second from a "point" source.

Pulsing

New techniques enable Van de Graaffs to be pulsed from a few nanoseconds to a millisecond. Instantaneous intensities as described above make feasible the consideration of hundreds of rads per pulse, or more than 10^{11} neutrons per burst.

High-energy linacs, now being supplied to physics laboratories, provide intense neutron pulses for time-of-flight studies. Typical of these machines are several built under AEC-sponsorship, which yield as high as 10^{17} fast neutrons per pulse at a rate of 1.5×10^{14} fast neutrons per second. The thermal neutron flux attainable with these machines is 10^{12} n/sec/-cm^2.



High-energy end of 12-Mev Tandem Van de Graaff Accelerator.

Photo courtesy University of Wisconsin

Energy Stability

It is now possible to consider stabilizing systems to a limit imposed primarily by the thermal motion of nuclear targets. With little effort, continuous particle-energy stabilities of a few tens of electron-volts can be provided.

Among the research fields in which these particle-accelerator characteristics may make a considerable contribution are: nuclear physics, biology, solid state, radiation damage, plasma physics, ignition of thermonuclear systems, and space-environment studies.

Physicists and radiation chemists at High Voltage Engineering are prepared to explore on an individual basis, long-range and immediate research problems that could utilize our accelerator systems.

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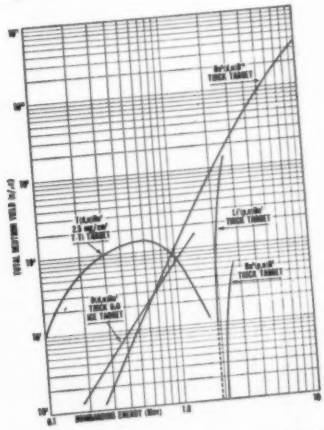
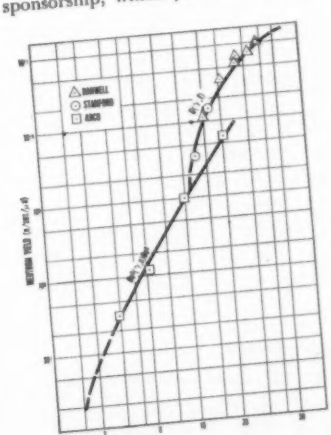


Neutron yields versus positive ion bombarding energy.



Photodisintegration neutron yields from X-rays produced in electron bombardment of large-atomic-number targets.

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Getting into College

(Concluded from page 24)

ther learning by your answers to his questions. Learning becomes even more fun when it is shared by all members of the family.

The child who is a natural reader presents no great problems. If your family includes a nonreader you have a special problem, but one which can sometimes be solved by introducing him to books which feed his natural interests. A librarian will help you select books which deal with baseball, with the mechanical world, with birds or animals, and, later on, books on electronics, chemistry, music, or art. Once your child has learned the fun of reading in the field of his special interest, there is a chance that he can be led into an exploration of other fields.

No College Is "Best"

You may wonder at this point why I have said nothing about marks and test scores. The omission of these two tyrannies is intentional. When learning is in its rightful place, marks and test scores follow learning. Today so much emphasis is placed on the difficulty of winning admission to college and on the importance of tests and marks that all too often marks and tests have become the goals of learning rather than the by-products. When marks and test scores are made the primary target of learning, real learning is lost.

The school report cards give you an opportunity to place marks in proper perspective. Instead of asking "What did you get?" try "What have you learned?"

It is up to you to de-emphasize the marks and test scores and to help your child focus on reading, writing, and learning. An approach like this as preparation for college helps your child to understand that learning is something he does where he is and that all about him are people and books which will help him later. Under such a program your child will see that his understanding of the world does not depend on whether he is in Boston, or in San Francisco, or in Yankton, but on how much advantage he takes of the opportunities around him. If your child is reared in this manner, neither he nor you will worry about whether he gets into Harprince, Dartyale or Calford, but only that he gets to a college where he can talk to teach-

ers, where he can read books, where he can work in the laboratory.

And now you may want to say, "Yes, but he may not get into a good college. He may not get into the best college. He may not get into my college." *Actually, no one knows what a good college is. No one knows which colleges are best.* Harvard does have more graduates in *Who's Who* than any other institution, but considering the human material that has poured into Cambridge, Mass., from all over the world for centuries, why doesn't Harvard have twice as many graduates in *Who's Who* as it does? Harvard could be doing a very poor job educationally and yet seem to be the top educational institution because of the intellectual drive and ability of the students who go there.

The head of the Department of Religion at Yale University is not a Yale man. He came from Dakota Wesleyan. The head of all health services at Harvard is not a Harvard man. He came from the University of West Virginia. The former president of Princeton was not a Princeton man, but a graduate of Grove City College in Pennsylvania. The misery and torture of today's college admission comes because parents have taught their children to think that learning is a matter of geography; that learning can take place only in certain institutions.

The wise parent who has created in his child a desire to learn will approach the whole problem of college admission with one philosophy: "Go where you can get in, my son, and know that a great opportunity awaits you to discover more about people, more about ideas, more about things—more knowledge than you will ever master in the four years you are in college."

When this approach to college admission is taken by an entire family there can be no heartbreaking letters in the mail, no crushed egos, nothing but delight at any letter that brings news of acceptance, news of an adventure in learning ahead.

Organists at Kresge

RECITALS IN the Kresge Auditorium at M.I.T. will be given December 6 by Piet Kee, February 14 by Donald McDonald, and April 11 by Heinrich Fleischer. The concerts will begin at 8:30, and single tickets will be $2.

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Books

(*Continued from page 34*)

1400 GOVERNMENTS, by Robert C. Wood, Associate Professor of Political Science at M.I.T.; Harvard University Press ($5.75). *Reviewed by Harold S. Osborne, '08, of Upper Montclair, N.J.*

THIS AUTHORITATIVE and readable book is the last to appear of a series of nine reporting a study made for the Regional Plan Association by the Graduate School of Public Administration of Harvard University dealing with the New Jersey-New York-Connecticut metropolitan area centering upon New York City. The purpose of the study is to identify and to analyze the forces which determine the future development of the region and to project for 25 years ahead the effect of continuation of the operation of these forces. This volume discusses the part played in the development of the region of the numerous governmental entities.

The author concludes that the governments of the region have relatively little influence in determining the pattern of growth and of distribution of population and of economic activity. To be sure, the governments perform many important and necessary functions. They tend, however, to follow rather than to direct the development.

The local governments are so numerous, so diverse and competing, and so limited in jurisdiction that their effects on shaping the region's development tend to cancel out. "The development of hundreds of separate policies in various combinations, among hundreds of jurisdictions, engenders a spirit of contentiousness and competition."

The greatest departure from this takes place in what the author calls the metropolitan giants. By this term he characterizes such agencies as the Port of New York Authority and the Tri-Borough Bridge and Tunnel Authority, which are given responsibilities in a restricted field but cover wide regional or subregional geographical areas. These agencies make important contributions to regional development but tend to support the market place and to underwrite and to accelerate the diffusion of people and of jobs.

In view of the growing complexity and diffusion of the provision of government services throughout this great region with the tremendous fragmentation of governmental responsibilities, the author inquires whether a revolution in governmental organization is impending. A major argument for such a revolution is that the local governments as now organized will find it increasingly difficult and ultimately impossible to provide for the widening demand for services under the limitations of the present tax system.

The author finds that these arguments are not convincing. To be sure, local governments are showing and may be expected to continue to show an increasing interest in regional problems and increasing co-operation in the attempt to do something about them. As for a revolution in governmental organization, however, the author states that the reformers suggest "the establishment of institutions which will insure the region's op-

(*Continued on page 62*)

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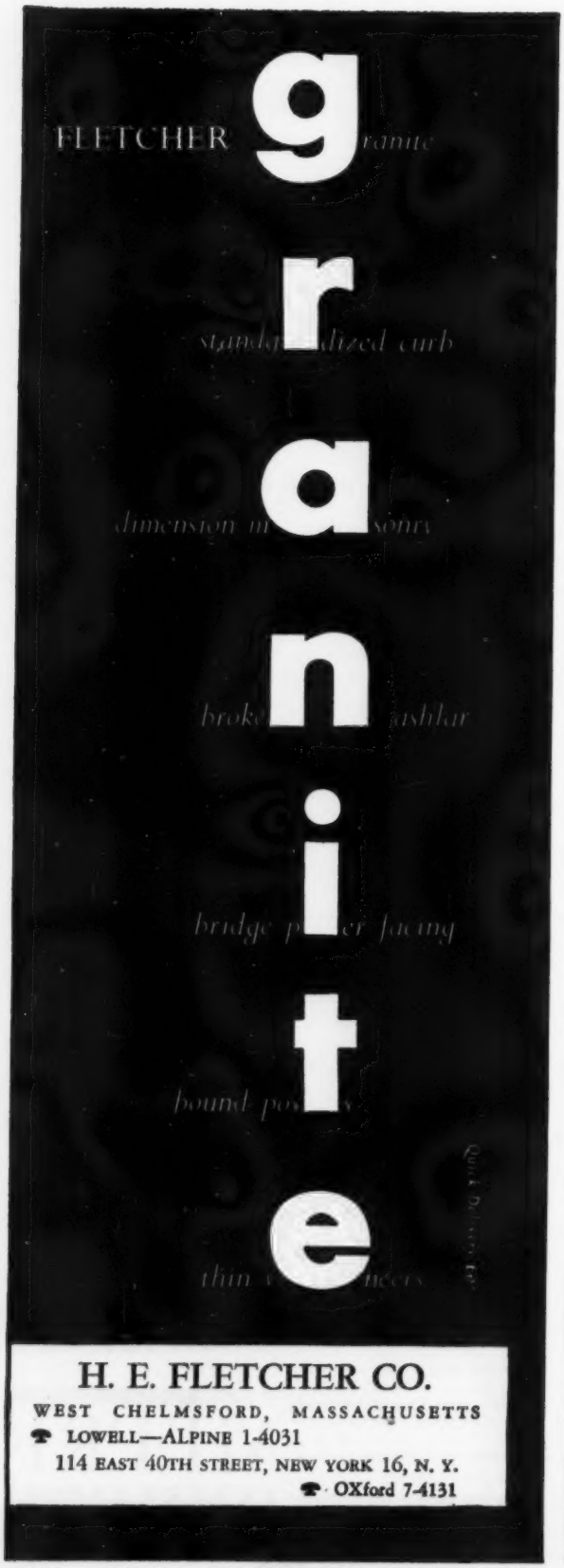
Ranking members of MITRE's technical staff will be conducting interviews during Nov. and Dec. in the following cities:
SAN FRANCISCO — Nov. 9, 10, 11 • SEATTLE — Nov. 13, 14, 15 • EULESS, TEXAS — Nov. 16, 17, 18 • WASHINGTON, D.C. — Dec. 4, 5, 6, 7.



Books

(*Continued from page 60*)

timum development and maximize the usefulness of the region's human and material resources." As to this, he has the following to say:

Yet the plain fact is, of course, that few inhabitants of the Region, or of the nation for that matter, have ever looked to their local governments to optimize *or* maximize *anything. On the contrary, people have regarded these units as necessary but not especially admirable service units to provide programs which did not seem supportable through private enterprise. It has never been in the Region's tradition to charge local government with the responsibility for physical and economic development. The price mechanism and the market place are our chosen instruments for those purposes.*

PARALLEL SKIING FOR WEEKEND SKIERS, by Robert C. Sprague, '23; Sprague Electric Company, North Adams, Mass. *Reviewed by Don Guy, skier, photographer, and Associated Press science writer.*

SKIERS, scientific or otherwise, who think that the only figures involved in their sport are cute little numbers in pink stretch pants will get a surprise from this slim but solid little volume. Written by the chairman of the board of the Sprague Electric Company, the book deals with the mathematics of skiing.

We anticipate seeing faculty mathematicians putting the book to the ultimate test with the first snowfall this winter. We visualize them schussing the slopes, volume in hand, as they check out the formula for turning:

$$Fl = \pm K_f W_s \frac{d}{12} \sin A \cdot (\sin C \pm f \sin C')$$

(Fl is the turning moment in foot pounds, K_f a constant depending on particular skis versus sliding friction with snow, W_s is weight of skier and A is angle of slope to horizontal, C is angle between longitudinal axis of the ski and fall line, $f = \frac{K_d}{\tan A}$, K_d is coefficient of friction of the skid.) The rest of us who have enough trouble getting downhill intact without worrying about the mathematics of our descent will learn a lot from Mr. Sprague's observations on parallel skiing.

The book includes a supplement based on Mr. Sprague's experience in teaching his daughter-in-law to ski at Bromley, Vt. The writer parts company with the traditional stem turn for beginners that has been the salvation and curse of skiers ever since it was imported from Europe. Some ski schools avoid stems or snowplow turns entirely. Others say it is a necessary evil to be outgrown as soon as possible. Mr. Sprague started his daughter-in-law off with parallel skiing the first day, having her step around with each traverse of a gentle slope. To this, many of us, remembering spills as we tripped over our own stem turns, will surely say amen.

(*Book news is concluded on page 64*)

M.I.T.'S SCIENCE REPORTER *on educational TV now is Dr. Elbert P. Little, former Executive Director of the Physical Science Study Committee. Boston's WGBH telecasts his programs at 9:30 P.M. on Wednesdays; they also are telecast in other cities.*

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Sensory Communication

Edited by Walter A. Rosenblith

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Books

(Concluded from page 62)

Have You Seen These?

RECENT BOOKS likely to be of especial interest to M.I.T. Alumni include:

Arms Control, Disarmament, and National Security, edited by Donald G. Brennan, '55, with the sponsorship of the American Academy of Arts and Sciences (Braziller, $6).

The Collected Works of Irving Langmuir, with an Honorary Editorial Advisory Board including William D. Coolidge, '96, and Horace R. Byers, '32 (Pergamon Press, 12 volumes, $150).

The Future Metropolis, edited by Professor Lloyd Rodwin of M.I.T., with contributions by Professors Gyorgy Kepes, Kevin A. Lynch, '47, Martin Meyerson, and others (Braziller, $5).

A History of Metallography, by Cyril Stanley Smith, '26, newly appointed Institute Professor at M.I.T. (University of Chicago Press, $8.50).

Miniaturization, edited by H. D. Gilbert, with a concluding chapter, "There's Plenty of Room at the Bottom," by Richard P. Feynman, '39—an article that attracted great attention when published in the May, 1960, issue of The Technology Review—(Reinhold, $10).

Plasmas and Controlled Fusion, by David J. Rose, '50, Professor of Nuclear Engineering, and Melville Clark, Jr., '43, Associate Professor of Nuclear Engineering (The M.I.T. Press and John Wiley & Sons, Inc., $10.75).

MAN'S VIEW OF THE UNIVERSE, by R. A. Lyttleton; Atlantic–Little, Brown ($3.95). *Reviewed by Martin Mann, '41, Senior Editor,* Popular Science Monthly, *and author of several science books for laymen.*

THIS little book is a collection of concise, encyclopedia-like chapters. You can breeze through it in an evening and collect the high points of modern knowledge of the heavenly bodies. Or you can browse for material that is new or intriguing—the chapters are independent enough to be enjoyed whether you have read the previous pages or not.

The organization is logical. Lyttleton starts with the earth, describing its structure and the way it may have been created. He then duplicates this formula as he moves out from the earth to the moon, planets, sun, comets, stars, galaxies, and entire universe.

The two chapters on comets may be the most interesting. Not many readers will realize that there are more of them than of any other celestial object in the universe (250,000 comets for every star). There is also plenty of "gee-whiz": the incomprehensible vastness of space (light, traveling six million million miles in a year, requires four and a half years to reach us from the star *nearest* to the sun), and the equally incomprehensible emptiness of space (a *dense* cloud of interstellar gas contains 1,000 hydrogen atoms per cubic centimeter, a density of 10^{-21} grams per cc.).

While brevity is to be applauded—this book is a paragon of that virtue—it does have drawbacks. Detail is severely limited. The drawings are apt and useful, the photographs beautiful but routine.

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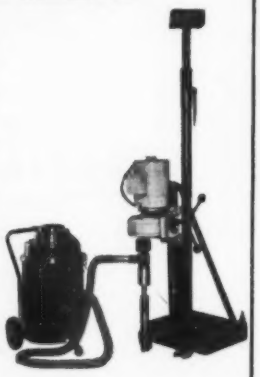

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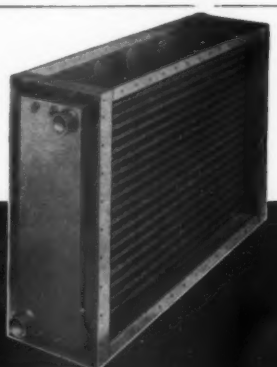

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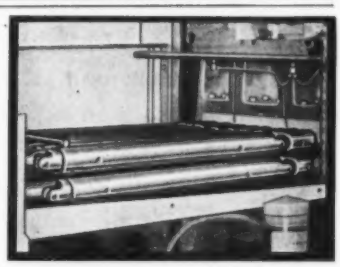

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Feedback

(Continued from page 3)

undiscovered or novel and become reduced to tedium after an initial mastery.

One of the "most wanted" easily characterized his first position: "I was not wanted for my education. The employer came to M.I.T. seeking a tolerably high intelligence quotient accompanied by a mechanical aptitude, and imagine, I was flattered because they seemed impressed by my A's in physics. When I arrived on the job they taught me what I was supposed to do—and woe to the rest of my education." A Ph.D., now teaching (few from the class have joined him), explained "Though the salary sacrifice is considerable, teaching provides the fullest possibilities for using my education." Upon continuing, he soberly reflected that the need for the teacher is premised upon the need for what he teaches. An electrical engineer jibed, "My day is composed of arithmetic and human relations—there is no time for technology."

Despite the drawbacks, some class members, responsive to their ability, have experienced considerable technological success in industry. These successes do not utilize to any greater degree the skills of those classmates with approximately equal ability who have experienced placement difficulties. The sudden defense layoffs in 1959 initiated a wave of address changes. "Termination," as described by one '56er, "constitutes a department captain bewailing that the company does not desire your leaving while he is astutely directing you to the door. Were I an escaping genie, someone would have rushed to put the lid on the jar. The jobs are explicit. When they are over, you are over."

About 10 per cent of the class have coped with the problems of engineering by engaging in completely unrelated occupations. One classmate finds being a rancher-art gallery operator absolutely delightful.

Perhaps the M.I.T.er could be considered overly self-indulgent for imagining the presence of opportunities to generally use his education. The arts major accepts his education as "good background" and adapts himself to, or more probably demands, job training by the employer. Apparently, exposure to the uninteresting is the calculated sacrifice for future success, "the good opportunity." What should allow the engineer, unlike others, to presume that the full interesting scope of his education will be utilized? No favoritism is asked. How-

(Concluded on page 68)

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Feedback

(Concluded from page 66)

ever, the discrepancy between all the pronouncements indicating this country has a shortage of engineers and its misuse of available talents exposes a fundamental national misunderstanding about the operations of technology. An unsound basis exists upon which to counsel a career-conscious high school student about engineering or the sciences.

For the public commentator, as well as the dedicated educator, the challenges of the space age appear to demand the fullest application of the best educated minds. Though the myriad secrets of the unknown could exhaust all our reserves of brilliance, our present status of technical advancement does not absorb existing talents. A first sensible plea is for honest disclosure in contrast with present flamboyant engineering personnel advertisement and procurement. A true appraisal, which would reveal vast engineering dreariness, could perhaps orient our efforts in more constructive directions. Those 85 out of every 100 who abandon engineering pursuits before achieving their degree might under a modified curriculum be qualified to fulfill the plethora of positions not requiring complete engineering credentials. Also, mass engineering tactics are deserving of review, regardless of the ultimate conclusion. In large engineering organizations, the long rows of drafting boards seem devised to provide the engineer with the personality of a potato.

Another awakening, compelling reevaluation of being "most wanted," is the recognition that the politics of business control the quality of engineering. As one of numerous representative examples of this realization, consider the Ph.D. who quit his job upon discovering that he was being used merely as "degree flavored stuffing" to "choicen" a cost-plus defense contract. Perhaps such abuse is the way of the world; however, the recognition of this possibility does not render compromise with responsible usage of quality education more tolerable.

These observations are particularly emphatic for the engineer or scientist in the 27-year-old range represented by M.I.T. '56ers. No longer an undergraduate spectator, the fifth-year Alumnus has become an active participant in society, with related commitments and dependency. The initial fascination, accompanying exposure to how business and its mentors operate, has worn thin. Now, a sensitivity to the demands of family life, present or prospective, and an awareness of more quickly passing years, plead for opportunities of substantial content, for the pride of usefulness and contribution.

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Associations with M.I.T.

FROM N. BRUCE DUFFETT, '40:
When my father and mother attended his 50th reunion at M.I.T., it occurred to me that my mother, Winona S. Duffett, was "related" to M.I.T. to an extent that might be quite unusual: husband, Norman Duffett, '11; son, N. Bruce Duffett, '40; brother, Erwin G. Schoeffel, '23; nephew, David E. Schoeffel, '51; brother-in-law, John F. Ancona, '03; and cousin, Malcolm F. Schoeffel, '25.

270 Park Avenue,
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Support for Our Critic

FROM CARL BARUS, '48:
I just read the letter in your April, 1961, issue from Frederic Langmack, '56. I hope it has stimulated similar comment from others. For my part I agree wholeheartedly with Mr. Langmack's criticism.

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Institute Yesteryears

(Concluded from page 38)

than had entered with the Class of 1889 in the previous autumn.

¶ Contrasts in Class meetings were reported by *The Tech* as follows:

"The Class of '89 had a hard time at their last meeting. By diligent work and by sending out scouts to bring in those who were playing tennis, the quorum of 40 was procured. The number for the quorum was then reduced to 25, and 15 men were allowed to go out. The remainder then settled down to business, but unfortunately accomplished nothing, none of the candidates obtaining a majority sufficiently large to elect them. Finally, the meeting was adjourned in despair.

"The Class of '90 held its first meeting in Rogers 15. . . . Great expectations were made, as a rush was expected with '89, and each student was compelled to show his first-year attendance card before entering the room. He then passed through a double line of 'sluggers' of the class before reaching the seats. No rush occurred, however, and as far as the upperclassmen were concerned, the meeting was enjoyed in peace.

"An attempt was made by some of the class to introduce electioneering tactics, and a printed ticket was got out. This attempt, however, resulted only in signal failure." Temporary officers were chosen and there was appointed "a committee of five to draw up a constitution and report in two weeks, when the permanent officers would be elected."

¶ "It is very hard for a student to be unable to spend Christmas at home, and yet this is the case with a great many of us at the Institute," wrote the editor of *The Tech*. "There is a constantly increasing number of students who come from a distance to pursue their courses of study here, and it seems to us as if some provision should be made for a Christmas holiday, so that they can pass that joyous festival at home.

"This is about the only prominent educational institution in the country where no Christmas holiday is given, and there seems to be a growing dissatisfaction among the students in regard to this.

"A week given as a holiday would only put off the semi-annual examinations, and make the second term begin and end a week later, thus taking it out of the very long summer vacation. . . . It is sincerely hoped that the Faculty will consider the matter favorably, and grant the much needed recess."

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and the prophet replied:
"It is well to give when asked, but it is better to give unasked, through understanding." •

Gifts by Will

TO THE

Massachusetts Institute of Technology

The tale is told of Almustafa, the prophet, who, having awaited for many years the ship that would return him to the place from whence he came, was making the final descent to the shore when the folk of Orphalese crowded about him. They besought him before departing to "disclose us to ourselves, and tell us all that has been shown you of that which is between birth and death."

With words of wisdom, an answer appropriate was given to the woman holding a baby, to the ploughman, to the merchant. Begged one, "Speak to us of GIVING," and the prophet replied:

> "It is well to give when asked, but it better to give unasked, through understanding;
> And to the open-handed the search for one who shall receive is joy greater than giving. All you have shall some day be given;
> Therefore give now, that the season of giving may be yours and not your inheritors'."

Through the years the prophet's words have held true, for even today he who "through understanding" includes the MASSACHUSETTS INSTITUTE OF TECHNOLOGY as a beneficiary in his will can experience thereby a two-fold satisfaction. The successful culmination of his search for a worthy recipient and the anticipated results his generosity will assist in accomplishing. These satisfactions give an added value to the span of man's days and protect his usefulness to his fellowmen far into the future.

The Massachusetts Institute of Technology because of the high quality of the education given its students, its effective research work for aiding America in peace as well as in war, and the high character of its governing body and academic staff qualifies as an institution for serving our American ideals for the present and in the years to come.

But the search, the finding, and the anticipated accomplishments are not enough; for without the properly-worded record, man's plans for the future may go awry. Hence the prophet's importuning, "—give now," should be heeded. The giving need not be an immediate physical transaction, for written directions replace the spoken word when the speaker is no longer present, and a donor can frequently make by will a gift which is larger than he can make while living. Truly, *"it is well to give when asked, but it is better to give unasked, through understanding."*

A booklet "Gifts by Will," outlining different forms of bequests to M.I.T., is available to you or to your attorney by writing to:

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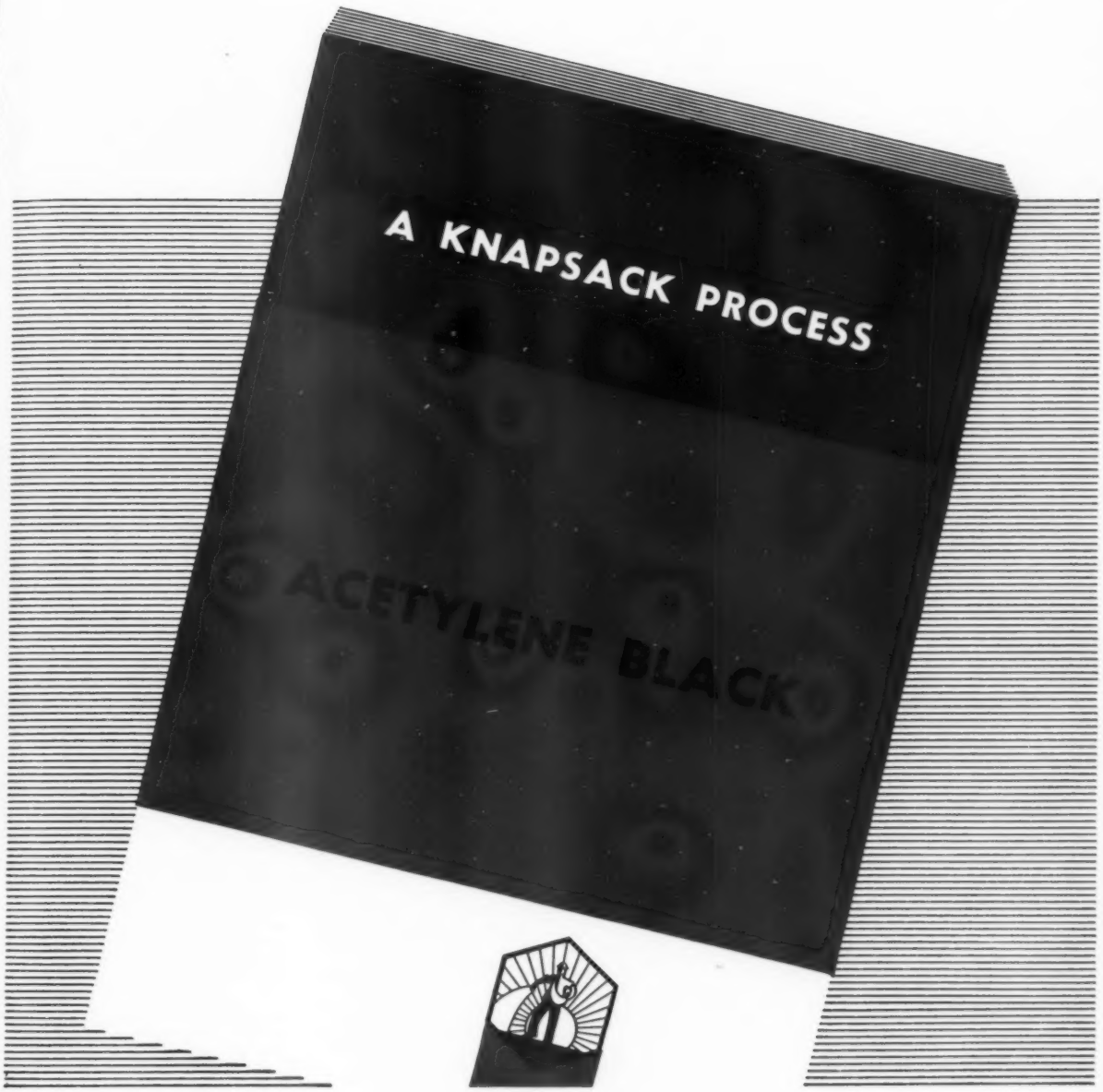
• The "Prophet" by Kahlil Gibran



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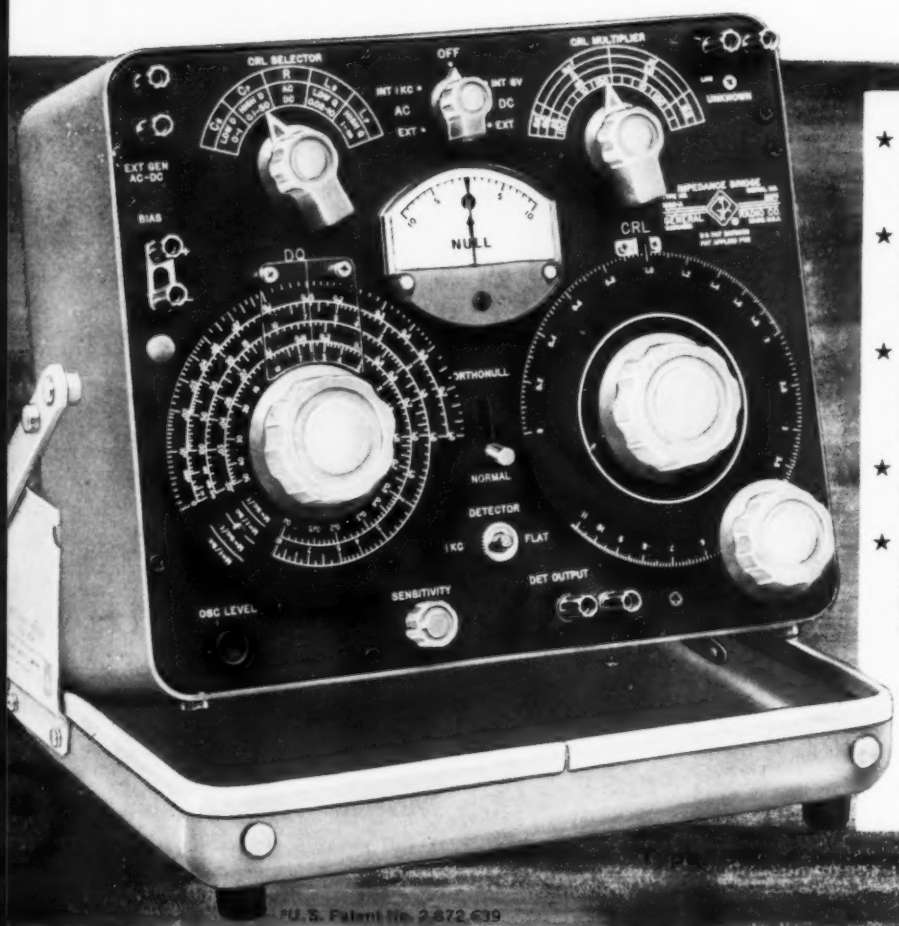

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